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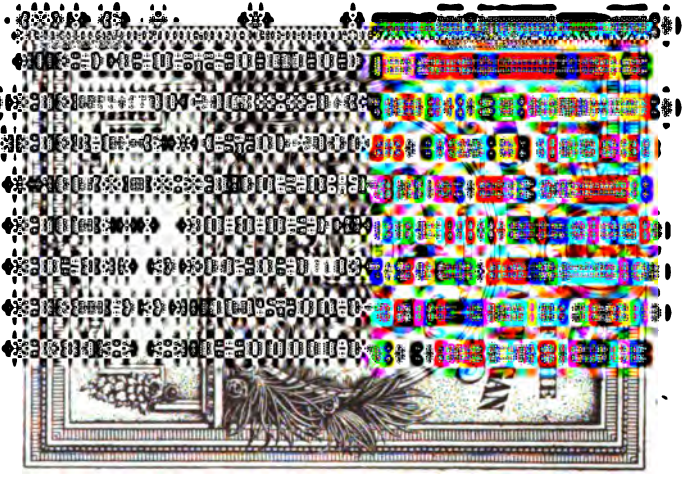

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MATERIA MEDICA

AND

THERAPEUTICS

INCLUDING

PHARMACY AND PHARMACOLOGY

BY

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TENTH EDITION
REVISED IN ACCORDANCE
WITH
THE U. S. PHARMACOPŒIA, IX
WITH INDEX OF SYMPTOMS AND DISEASES

PHILADELPHIA
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PREFACE TO THE TENTH EDITION

The appearance of the United States Pharmacopœia, IX, has necessitated a rewriting of the section devoted to Pharmacy and Materia Medica and a thorough revision of this volume, which treats of the official drugs and preparations only, and every effort has been made toward condensation so far as is compatible with clearness. In order that the subjects might be presented in one volume and all repetitions avoided, cross references have been inserted and an exhaustive index added for the convenience of physicians who use this as a book for reference. The many advances have necessitated the division of the work into two distinct parts, the first being devoted to Materia Medica and Pharmacy, in which full attention is given to pharmaceutical processes, to the various kinds of preparations, with their dosage, and to the art of prescribing; after which the description of remedies is taken up in detail. The therapeutic agents are divided into two sections, the Inorganic and Organic Materia Medica, and the general classification adopted is one based on the grouping of the articles according to the chemical or physiological divisions to which each belongs. The course of instruction on Materia Medica should include the performance of the simpler pharmaceutical operations, demonstrations of the drugs and preparations, and practice in prescription writing. It is believed best that the substance should be learned first and then its uses. In the second part, dealing with Pharmacology and Therapeutics, the classification employed is based on the particular physiological system upon which the various agents principally act. There is a compete presentation of the official remedies and very elaborate accounts of their pharmacological action and therapeutic uses. In these descriptions the effort has been made to present the latest views of the highest authorities in these departments, and to render the book as practically useful as possible by full details regarding treatment which have been found to be valuable in actual practice. The course on Pharmacology and Therapeutics should include

laboratory and clinical demonstrations in the use of remedial agents. The index of Symptoms and Diseases should be used for prescribing only after reference to the individual remedies and their indications in order that the method of their employment and the especial condition and period for which they are useful may be accurately determined. This volume offers to the medical student and to the practitioner, it is believed, a very complete presentation of the resources at our command, (Materia Medica), how they act (Pharmacology), and, finally, how to employ them (Therapeutics).

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PART I. MATERIA MEDICA AND PHARMACY

DEFINITIONS

Materia Medica.—The materials used in the treatment of disease.

Pharmacy.—The art of preparing drugs in a form suitable for use, as remedial agents, and of dispensing them.

Pharmacopœia.—A code of remedial agents, usually with descriptions, definitions or directions, prepared by experts appointed by authority, and intended to serve as a standard until superseded by a new one. By admitting certain articles to its pages, it declares them to be of importance, through the extent of their use, or to be entitled to confidence because of their value, or both, in the practice of medicine, but does not, necessarily, deny these properties to articles not admitted. It fixes their official title or titles and abbreviations, doses, and often their leading synonym or synonyms. Usually it defines them, describes them with completeness sufficient to provide for identification and determination of the proper degree of purity, or strength, or both, and details and recommends such operations in preparing them as pertain to a dispensing pharmacy. It may, in addition, provide rules, formulas, tables, and other information of importance in the practice of pharmacy and medicine. Everything contained in the United States Pharmacopœia (abbreviation "U. S. P.") is said to be "official."

The United States Pharmacopœia is prepared by a committee, meeting at the beginning of each decade, elected by a Convention of delegates, appointed by invitation extended by the President of the preceding Convention, to all incorporated medical and pharmaceutical societies and colleges, and to the United States Army, Navy, and Marine Hospital Service. The U. S. P. is the authority by Act of Congress, in the conduct of the Department of Customs, Bureau of Chemistry, of the Army, Navy, and Marine Hospital Service, and of the District of Columbia and other Territories within the jurisdiction of the United States laws. By legislative enactment it is

also made a legal authority within the jurisdiction of many States. The present revision became official on September 1, 1916.

PHARMACY

Pharmacy covers a field of nearly as much importance, breadth and difficulty as that of medicine itself, and requires a special, extensive and thorough preparation. It should never be practised by the physician, when the services of a competent manufacturing or dispensing pharmacist can be utilized. The physician should, however, be acquainted with the general principles and most of the details of the science and art of Pharmacy, that he may judge intelligently of the services rendered him by the pharmacist, and also be prepared to act with safety himself in cases of emergency. A pharmaceutical education to this extent, accompanied by dispensary practice, should be provided for in every thorough course of medical study.

TERMS APPLIED TO SUBSTANCES OF VEGETABLE ORIGIN

Alkaloids.—(Their English names terminating in *ine*, their Latin names terminating in *ina: ia*, occasionally found in literature, is officially obsolete.) Compounds of carbon, hydrogen and nitrogen, and usually containing also oxygen, either existing in the plant as proximate principles, or being derived from other alkaloids, having basic properties, and forming salts, usually crystallizable, with acids, without displacing any of the hydrogen of the latter. The chief characters are as follows:

1. Either (*a*) solid, mostly crystalline and colorless, non-volatile, or (*b*) liquid and volatile.
2. They turn red litmus paper blue.
3. They are soluble in alcohol, chloroform, petroleum benzin, benzene, and often in ether. They are insoluble in water, but not so their salts, while the latter are insoluble in chloroform, ether, petroleum benzin and benzene.
4. They are usually precipitated from saline solution by alkalies.
5. One or more of the following will precipitate them: tannic, phosphomolybdic or picric acid, potassio-mercuric iodide, or auric chloride.
6. Their solutions are usually intensely bitter.

Alkaloids, as a class, are the most energetic and important medicinal constituents of plants. Examples in U. S. P.: Atropine, Morphine, Strychnine.

Artificial Alkaloids.—Some can be produced by synthetic processes.

Example in U. S. P.: Theophyllina, which also is found in the plant.

Others are made from alkaloids obtained from plants.

Examples in U. S. P.: Apomorphina, official as the hydrochloridum, Homatropina, official as the hydrobromidum, and Hydrastinina, official as the hydrochoridum.

Glucosides.—(Their English names terminating in *in*, their Latin names terminating in *inum*.) Bodies which, under the influence of heat, dilute acids, strong alkalies, enzymes, certain fungi or bacteria, split up into glucose or rarely some other sugar and other substances as alcohols, aldehydes, phenols.

Examples in U. S. P.: Salicinum, Strophanthinum.

Amaroids or Bitter Principles (their names ending in *in* and *inum* as above) are of such varied nature that they do not admit of any chemical classification. The term includes all distinctly bitter extractives of definite chemical composition other than alkaloids and glucosides.

Glucosides and Amaroids are not the only principles whose names end in *in*.

Fixed Oils are those which cannot be distilled without decomposition. They are esters of the higher fatty acids which at ordinary temperatures remain liquid. The fatty acids commonly entering into the composition of fixed oils are oleic, palmitic, and stearic.

Example: Olive oil consists of a mixture of a combination of oleic acid ($C_{18}H_{34}O_2$) with glyceryl (C_3H_5) = olein and palmitic acid ($C_{16}H_{32}O_2$) with glyceryl = palmitin. In it there is thus a mixture of two oils having the formulæ $C_3H_5(C_{18}H_{33}O_2)_3$ and $C_3H_5(C_{16}H_{31}O_2)_3$ respectively.

When acted upon by caustic alkalies or metallic oxides, these form soaps (oleates, palmitates, or stearates of metals) and glycerin. This process is called saponification, *e.g.*, $C_3H_5(C_{18}H_{33}O_2)_3 + 3NaOH = 3NaC_{18}H_{33}O_2$ (Sodium Oleate) $+ C_3H_5(OH)_3$ (Glycerin).

Fixed oils are obtained by expression or by boiling with water and skimming off the melted oil, from the fruits or seeds of plants, or from animal tissues. When pure they are usually colorless or pale yellow; they float on water and cause a greasy mark on paper. With very few exceptions, owing to their large content of olein, they are liquid at ordinary temperatures. They are soluble in ether, chloroform, turpentine and volatile oils.

Examples in U. S. P.: Oleum Amygdalæ Expressum, Gossypii Seminis, Lini, Morrhuæ, Olivæ, Ricini, Tiglii.

Fats are fixed oils which are solid at ordinary temperatures owing to their larger content of palmitin and stearin, $C_3H_5(C_{18}H_{31}O_2)_3$; if extracted by expression, sufficient heat to melt them must be used.

Examples in U. S. P.: Oleum Theobromatis, and Adeps.
The same definitions will apply to fixed oils and fats of animal origin.

Waxes are chiefly composed of fatty acids combined with monohydric alcohols homologous with methyl alcohol. They contain no glyceryl, however, and are brittle at low temperatures.

Volatile or Essential Oils are those peculiar principles to which, in a majority of instances, the odor of plants is due. They may preexist in the plant and be obtained by distillation, *e.g.*, Oleum Terebinthinæ, or by expression, *e.g.*, Oleum Limonis; some are the result of enzyme action upon certain constituents of the plant, *e.g.*, Oleum Sinapis Volatile. They do not leave a greasy mark on paper, and resemble fixed oils only in being soluble in the same media. They do not become rancid, but on exposure to light and air may change to resins. They are mostly inflammable, and mostly lighter than water. They are highly odorous and aromatic, and sufficiently soluble in water to impart their odor and taste to it. Most are prepared by distillation—that is, by passing a current of steam through the substance from which they are extracted; the steam is condensed, and the oil either floats to the top or sinks to the bottom of the water. Their composition varies greatly and is often complex. They are of four classes:

(*a*) **Terpenes,** which consist of carbon and hydrogen; *e.g.*, Oleum Terebinthinæ.
(*b*) **Oxygenated,** containing oxygen, *e.g.*, Oleum Eucalpyti.
(*c*) **Sulphurated,** containing sulphur; *e.g.*, Oleum Sinapis Volatile.
(*d*) **Nitrogenated,** containing nitrogen; *e.g.*, Oleum Amygdalæ Amaræ.

They may contain aldehydes, phenol derivatives, ethers or ethereal salts, alcohols or ketones, generally associated with terpenes of varying composition.

Resins are of very indefinite composition. They are among the products of oxidation of volatile oils, being usually oxidized terpenes. They are solid, mostly uncrystallizable, fusible, not volatile, combustible, insoluble in water, mostly soluble in alkalies and

volatile oils, and also in one or more of the following: alcohol, ether, chloroform, and fixed oils. Since they are insoluble in water, but not in alcohol, they may be prepared by extraction with alcohol and precipitation with water. Those which combine with alkalies form resin soaps. When occurring naturally, there are usually two or more resins mixed.

Those in the U. S. P. are Resina Jalapæ, Podophylli, and Scammoniæ.

Oleoresins are natural solutions of resins in volatile oils.

Those in the U. S. P. are Oleoresina Aspidii, Capsici, Cubebæ, Petroselini, Piperis, and Zingiberis.

Balsams are resinous or oleoresinous exudates. The U. S. P. articles are liquid or soft products and contain an odorous principle, which is benzoic, or cinnamic acid, or both.

Those in the U. S. P. are Balsamum Peruvianum and Tolutanum, and Styrax. Not all substances having a balsamic odor are balsams; *e.g.*, Benzoinum is a resin and Copaiba, sometimes known as Balsam of Copaiba, is an oleoresin.

Resins containing benzoic or cinnamic acids are sometimes called solid balsams.

Gums are exudations from plants, having an insipid taste, insoluble in ether and alcohol, and in water either dissolving to form a mucilage or swelling to form an adhesive jelly. They consist of one or more of the following:

(*a*) Arabin or soluble gums, *e.g.*, Acacia.
(*b*) Bassorin or partially soluble gums, *e.g.*, Tragacantha.
(*c*) Cerasin or insoluble gum.

Gum-resins are exudations from plants consisting of a natural mixture of one or more gums and oleoresins. When they are rubbed with water the gum dissolves and the resin remains mechanically suspended in the solution, forming an emulsion.

The U. S. P. gum-resins are Asafœtida, Cambogia and Myrrha.

PHARMACEUTICAL PROCESSES

Many of these, as filtration, precipitation, need no explanation.

Carbonization is the heating of organic substances without exposure to the air until the volatile constituents are driven off and the residue assumes the characteristic appearance of carbon.

Clarification is a process for making liquids transparent by separating from them, without the use of filters or strainers, such solid substances as render them turbid. It is most commonly effected by the application of heat, though filtration or decantation must always be subsequently resorted to for removing the separated matter. Other means employed for clarifying are: By increasing the fluidity of the liquid, by the use of egg-albumin, gelatin, milk, or paper-pulp; by subsidence through long standing (often applied to fixed oils); and by fermentation (as in the case of fruit juices).

Comminution is the process of reducing drugs to particles, or breaking up their state of aggregation. It is effected by cutting, slicing, chopping, the use of drug-mills, etc.

Decoloration of liquids is usually effected through the agency of animal charcoal.

Dialysis is the process of separating crystalloids from colloids by bringing them, in a mixed solution, into contact with one side of a membrane, such as a bladder, parchment or parchment paper, which has water on its other side, and resulting in the passage into the water of the crystalloid to form the "diffusate," the remainder, the colloid, constituting the "dialysate."

Displacement is another name for Percolation.

Elutriation is a process for obtaining a substance in fine powder by diffusing an insoluble powder in water. The larger and heavier particles having sunk to the bottom of the vessel, the supernatant fluid is decanted into another vessel, where the lighter particles are collected. The process may be repeated, if necessary. To facilitate the drying of the powder thus obtained, the soft mass, or **magma**, after having been drained, may be formed into small conical masses on warm porous tiles. Prepared chalk is an example of an elutriated powder.

Expression is the forcible separation of liquids from solids by means of pressure. Hand-pressure through straining-cloths may be employed, but mechanical processes are more efficient.

Fusion is the process of liquefying solid bodies by the application of heat, as in the melting of wax and the preparation of moulded silver nitrate.

Granulation is a process by which certain substances soluble in water are obtained in the form of coarse powder by simple evapora-

tion of their solution, with constant stirring, until all moisture is dissipated.

Levigation consists in reducing a drug to powder by triturating it with a little water and drying the resulting paste.

Lixiviation is the practice of exhausting substances, which have been incinerated, as, for instance, wood-ashes, of their soluble constituents by pouring water upon them after their introduction into a conical-shaped vessel; the resulting solution being called a "lye."

Maceration is the extraction of the soluble portions of a substance which is not wholly soluble in the menstruum, by prolonged contact therewith.

Massing is the important step in the preparation of pills by the formation of a proper mass, which should consist of a firm, consistent paste, sufficiently plastic to admit of being moulded without adhering to the moulds and sufficiently firm to prevent the pills from losing shape. Some substances, such as gums and resinous drugs, possess the requisite adhesiveness in themselves but need the addition of a liquid—water or alcohol—in order to develop it. Others have no inherent adhesive properties, and with them it becomes necessary to impart tenacity by the addition of some liquid or solid material, which is called the **excipient**. Excipients must be added judiciously, so that the constituents of the mass may not be modified in their action or the bulk be unnecessarily increased; and after each addition the mass should be well kneaded. In order to insure homogeneity of the mass, and also the subsequent accurate division of doses, all the constituents should, whenever possible, be reduced to a fine powder. Small quantities of potent remedies, such as alkaloids or narcotic extracts, are preferably triturated with a little sugar of milk before mixing them with the other ingredients, to facilitate uniform distribution.

Percolation consists of the extraction in a suitable vessel (the "percolator") of the soluble constituents of a powder by the descent through it of a solvent (the "menstruum"), the resulting solution being called the "percolate." The **marc** is the material after its exhaustion by maceration or percolation. Percolation enters into the manufacture of a great majority of the official preparations of organic drugs.

Repercolation consists in using the liquid obtained from a sub-

stance as the menstruum for percolating successive portions of the same substance.

Pulverization is the reduction, by mechanical means, of a substance into fine particles. Like *grinding*, applied to the production of coarse particles, it is very largely carried on by drug-millers. Before pulverizing, a substance must be dried, and the desired fineness of the powder determines the character of the preliminary treatment. Thus, drugs containing volatile oils are apt to be rendered worthless if they are dried sufficiently to enable them to be ground very finely, and hence they are preferred when coarsely powdered. The processes for extracting the soluble principles having been very greatly improved, the necessity no longer exists for using the very fine powders, and therefore the volatile principles are not sacrificed. *Pulverization by intervention* is the process of reducing substances to powder through the use of a foreign substance, from which the powder is subsequently freed by some simple method.

Scaling is the drying of concentrated solutions of drugs on glass plates; after which the solid film, the scale, thus left is broken up. Some preparations of iron are obtained by scaling.

Separation of liquids which do not mix with each other is a mechanical process accomplished with pipettes or with funnels having stopcocks in their necks. Special forms of receivers are used for the separation of volatile oils from the water accompanying them during distillation.

Solution is the process by which a solid, gaseous, or liquid substance, when brought into contact with a liquid, becomes molecularly blended with it in such a way that a permanent homogeneous fluid results; and the resulting fluid is known as a solution. The liquid employed for effecting solution is termed a *solvent* or **menstruum.** In cases where it is incapable of entirely dissolving a substance the solution is called a *saturated* one when all of the substance that is possible for it to dissolve has been taken up. A substance which altogether resists solution is said to be **insoluble.** It should be noted that when certain solids are brought together by means of trituration, solutions result. This effect is seen, for instance, when camphor is rubbed up with menthol or with hydrated chloral. Solution is facilitated by agitation, and in most cases by the application of heat. Solution may be either **simple** or **chemical.** In the first the substance dissolved undergoes no change except as

regards its physical condition. In chemical solution more or less alteration occurs in the properties of both the solvent and the substance dissolved. The percentage strength of solutions is either chemical or pharmaceutical. The chemical considers only weight and not volume; *e.g.*, 10 gm. of a substance added to 90 gm. of a solvent, both being weighed, makes a 10 per cent. solution. The pharmaceutical is based upon the fact that solids are weighed and liquids measured so that if 10 gm. of a weighed substance are dissolved in a liquid menstruum and sufficient menstruum is added to make it measure 100 mils, the strength of the solution is 10 per cent.

Standardizing consists in determining an upper or lower limit, or both, of the active constituent which a drug or its preparation must contain in order to be official, and prescribing an appropriate process for its determination. Where chemical methods have been proved to be inadequate, biological assays have been adopted. These are obligatory for Liquor Hypophysis and Cannabis and its preparations, and specified for Aconitum, Digitalis, Strophanthus, Scilla, Suprarenalum Siccum and their preparations. The standards adopted will be found in the descriptions of drugs and preparations.

Sublimation is the process of separating a volatile solid substance, from one which is not volatile, by the application of heat. The product is termed a *sublimate*. The objects of sublimation are: (1) to purify volatile solids from admixed and fixed impurities, and (2) to provide a convenient means of collecting volatile solids resulting from chemical reaction at high temperatures.

Trituration is the reduction of substances to fine particles by continued attrition in a mortar. When the substance is rubbed with sugar of milk, which is an inert and gritty powder, the product is designated a *trituration*.

WEIGHTS, MEASURES, AND SYMBOLS

Weights (Apothecaries' or Troy weight)

1 grain.....symbol, gr.
60 grains = one DRACHM.....symbol, ℥
480 grains = one OUNCE.....symbol, ℥
12 ounces = one POUND.....symbol, lb.

The scruple, 20 grains (symbol ℈), is rarely used.

Measures of Capacity

1 minim		symbol, ♏
60 minims	= one FLUID DRACHM	symbol, ℥
8 fluid drachms	= one FLUID OUNCE	symbol, ℥
16 fluid ounces	= one PINT	symbol, O
8 pints	= one GALLON	symbol, C

Usually ℥ and ℥ are written f℥ and f℥ when they stand for fluid drachms and fluid ounces.

Relations of Measures to Weights

1 minim	is the measure of	0.95 grains of water.
1 fluid drachm	is the measure of	56.96 grains of water.
1 fluid ounce	is the measure of	455.69 grains of water.
1 pint	is the measure of	7291.04 grains of water.

A pharmaceutical 1 per cent. solution is approximately a grain in 110 minims.

A fluid grain is the volume of one grain of water at 15.5°C.; 60°F., that is to say, it is a little over a minim (1.05 ♏).

In the pharmacopœial description of the various proportions which several parts of a compound bear to one another, the word parts means parts by weight, the term fluid parts signifies the volume of an equal number of parts of water.

Metrical System.—This, which is as follows, is official in the U. S. P. for the making of drugs and preparations. The United States Bureau of Standards having declared that the term cubic centimetre is a misnomer because there is a slight difference between the thousandth part of a litre and the cubic centimetre, (1 litre being equivalent to 1.000027 cubic decimetres), millilitre (abbreviation, mil) is substituted therefor.

WEIGHTS

1 milligramme = 0.001 gramme.
1 centigramme = 0.01 gramme.
1 decigramme = 0.1 gramme.
1 gramme (abbreviation, gm.) = weight of 1 mil of distilled water at 4°C.; 39.2°F.
1 dekagramme = 10.0 grammes.
1 hektogramme = 100.0 grammes.
1 kilogramme (abbreviation, kilo.) = 1000.0 grammes.

MEASURES

1 millilitre (abbreviation, mil) = the measure of 1 gm. of water.
1 centilitre = 10 mils = the measure of 10 gm. of water.
1 decilitre = 100 mils = the measure of 100 gm. of water.
1 litre = 1000 mils = the measure of 1000 gm. (1 kilo.) of water.

Conversion of United States to Metrical Weights and Measures

WEIGHTS

1 grain	=	0.0648 gm.
1 ounce	=	31.103 gm.
1 pound	=	373.250 gm.

MEASURES

1 minim	=	0.0616 mil.
1 fluid drachm	=	3.75 mils.
1 fluid ounce	=	29.57 mils.
1 pint	=	473.18 mils.
1 gallon	=	3785.43 mils.

Conversion of Metrical to United States Weights and Measures

WEIGHTS

1 milligramme	=	0.015432 grain.
1 gramme	=	15.43235 grains.
1 kilogramme	=	15432.356 grains.

MEASURES

1 millilitre	=	16.23 minims.
1 litre (1000 mils)	=	33.81 fluid ounces.

In prescribing on the Continent of Europe all liquids are weighed and the weight used for both liquids and solids is grammes, but this word is not expressed. Thus—

Magnesii sulphas	20.0 = 20 grammes of magnesium sulphate.
Hydrargyri chloridum mite	0.5 = half a gramme of mild mercurous chloride.
Tinctura rhei	1.5 = a gramme and a half of tincture of rhubarb.

Domestic Measures

A TEA-SPOONFUL is about a fluid drachm (4 mils). Usually it is more, viz., nearly 5 mils.

A DESSERT-SPOONFUL is about two fluid drachms (8 mils).

A TABLE-SPOONFUL is about half a fluid ounce (16 mils). Usually it is about 20 mils.

A WINE-GLASSFUL is about one and a half to two fluid ounces (45 to 60 mils).

A TEA-CUPFUL is about five fluid ounces (150 mils).

A BREAKFAST-CUPFUL is about eight fluid ounces (240 mils).

A DROP is often taken as being a minim, but drops vary so much in size that they should never be used for children, nor as a measure of powerful drugs. For example, the number of drops in a fluid drachm of the official Syrup of Acacia is 44, of Water 60, of Alcohol 146, of Chloroform 250.

Spoons, glasses and cups vary so much in capacity that it is never safe to prescribe solutions of powerful drugs to be measured by them. The use of glass graduates, which can be obtained accurately marked, should be insisted upon.

PHARMACOPŒIAL PREPARATIONS AND THEIR DOSES

Most drugs, in their natural state, are not suitable for administration. They are either too bulky, too nauseous, or contain noxious principles. Preparations suitable for administration are, therefore, prepared from them according to "official" pharmacopœial directions. The doses of the various official drugs and their preparations which may safely be administered are those given in the last revision of the United States Pharmacopœia. These doses are intended to be "the average approximate (but neither a minimum nor a maximum) dose for adults." But these often may not be rigorously adhered to in prescribing, because they vary with the purpose for which the drug is required and the age of the patient. The following is an account of the preparation of the official remedies, with the doses so arranged that they may be readily memorized.

Unless otherwise specified, the preparations are for internal use.

Aceta (Vinegars).—Liquid preparations resulting from the extraction of the drug with dilute acetic acid, and filtering. The U. S. P. contains:

	Dose
Acetum Scillæ	1 mil (15 ♏.)

Aquæ Aromaticæ (Aromatic Waters).—Preparations made by impregnating water with a volatile substance. Aromatic waters, when prepared from volatile oils, are intended to be, as nearly as practicable, saturated solutions, which must be clear and free from solid impurities, and unless otherwise directed, should be made by the following general process: Volatile oil, 2; purified talc, 15; distilled water, recently boiled, 1000. Triturate the volatile oil with the purified talc, add the distilled water gradually with continued trituration, filter and pass the filtrate through the filter repeatedly until the Aromatic Water is perfectly clear. Those in the U. S. P. thus made are:

	Dose		Dose
Aqua Camphoræ	10 mils (2½ fl. dr.).	Aqua Fœniculi	15 mils (4 fl. dr.).
—Amygdalæ Amaræ	15 mils (4 fl. dr.).	—Menthæ Piperitæ	
—Anisi		——Viridis	
—Cinnamomi			

Five are made by distillation:

	Dose		Dose
Aqua Destillata	indeterminate.	Aqua Hamamelidis	indeterminate.
——Sterilisata		—Rosæ Fortior	
—Aurantii Florum Fortior			

Four are simple solutions in distilled water:

	Dose		Dose
Aqua Creosoti	10 mils (2½ fl. dr.).	Aqua Rosæ	indeterminate.
—Chloroformi	15 mils (4 fl. dr.).	—Aurantii Florum	

Two are made by passing gases through water:

	Dose		Dose
Aqua Ammoniæ Fortior.	indeterminate.	Aqua Ammoniæ	1 mil (15 ♏).

Cerata (Cerates).—Adhesive preparations for external use, containing wax, capable of being spread at ordinary temperatures, and not melting at the temperature of the body. Three are official in the U. S. P.:

Ceratum	Ceratum Cantharidis.	Ceratum Resinæ.

Collodia (Collodions).—Preparations for external use, either simple collodion (a solution of pyroxylin in ether and alcohol) or collodion impregnated with an active substance. When applied externally a protective film is formed, owing to the rapid volatilization of the solvent. The U. S. P. contains three:

Collodium.	Collodium Cantharidatum.	Collodium Flexile.

Decocta (Decoctions).—Liquid preparations of organic drugs. Decoctions must be *freshly made from the drugs*, and when the strength is not otherwise directed they are to be prepared by the following general process: The drug, 50; water to 1000. Introduce it into a suitable vessel provided with a cover, pour upon it the water, cover it well, and boil for fifteen minutes. Then allow it to cool to about 40°C. (104°F.), express, strain the expressed liquid, and pass enough cold water through the strainer to make the product measure 1000. The strength of decoctions of energetic or powerful substances should be specially directed by the physician. The U. S. P. at present contains none.

Elixira (Elixirs).—Sweet and aromatic liquid preparations, used for flavoring medicines. There are two in the U. S. P.:

	Dose
Elixir Aromaticum	indeterminate.
—Glycyrrhizæ	

Emplastra (Plasters).—Tenacious preparations for external application, solid at ordinary temperatures, but pliable and adhesive at the temperature of the body. Those of the U. S. P. are:

Emplastrum Belladonnæ	Emplastrum
—Cantharidis	—Plumbi
—Capsici	—Resinæ
—Elasticum	—Sinapis

Emulsa (Emulsions).—Liquid preparations consisting of oily or resinous substances held suspended in water which has been rendered mucilaginous or viscid. Acacia and tragacanth are frequently used to form emulsions. Acacia is incompatible with ferric chloride, borax, and lead subacetate. Emulsions are coagulated by acids, an undue proportion of metallic salts, and spirituous liquids. There are in the U. S. P.:

	Dose
Emulsum Olei Terebinthinæ	2 mils (½ fl. dr.).
—Olei Morrhuæ	15 mils (4 fl. dr.).
—Asafœtidæ	
—Amygdalæ	indeterminate.

Extracta (Extracts).—Extracts are solid or semi-solid preparations not agreeing in strength, made by evaporating the solutions to the required consistence. Pilular extracts are solid or semi-solid products prepared by exhausting the drug with appropriate solvents and carefully evaporating the solutions to the proper consistence. The solvents or menstrua employed are water, alcohol, or mixtures of these in various proportions; a few require the addition of an acid or an alkali to the solvent. Powdered extracts are dry, fine powders. Solvents are used which will extract the active principles of the drugs, and only a minimum amount of the inert substances. The final drying to the soft extract can be facilitated by spreading it upon plates of glass or tinned metal and exposing it to currents of warm, dry air. There are in the U. S. P.:

	Dose		Dose
Extractum Physostigmatis	0.008 gm. = 8 milligm. (⅛ gr.).	Extractum Cimicifugæ	0.250 gm. = 250 milligm. (4 gr.).
—Aconiti		—Colocynthidis Compositum	
—Cannabis	0.010 gm. = 10 milligm. (⅙ gr.).	—Ergotæ	
—Gelsemii		—Gentianæ	
—Stramonii		—Hydrastis	
—Belladonnæ Foliorum	0.015 gm. = 15 milligm. (¼ gr.).	—Cascaræ Sagradæ	
—Nucis Vomicæ		—Rhei	
—Colocynthidis	0.030 gm. = 30 milligm. (½ gr.).	—Sumbul	
—Opii		—Viburni Prunifolii	
—Colchici Cormi	0.06 gm. = 60 milligm. (1 gr.).	—Taraxaci	1 gm. (15 gr.).
—Hyoscyami		—Malti	15 gm. (4 dr.).
—Fellis Bovis	0.10 gm. = 100 milligm. (1½ gr.)	—Glycyrrhizæ	indeterminate.
		—Purum	

Fluidextracta (Fluidextracts).—These are concentrated liquid preparations of vegetable drugs, containing alcohol either as a solvent or as a preservative, and bearing a uniform relation to the drug used so that *one mil* of the fluidextract closely represents the activity of *one gramme* of the air-dried and powdered drug of standard quality. They are of four classes: (*a*) Those made with a menstruum of alcohol or a mixture of alcohol and water by the usual process of percolation. (*b*) Those made by using glycerin or an acid in the extraction; the first menstruum contains the glycerin or acid and the second, a mixture of alcohol and water for completing the exhaustion of the drug. (*c*) Those made by the process of fractional or divided percolation. (*d*) Those made by infusion and percolation with boiling water, alcohol being added to the concentrated liquid as a preservative. There are in the U. S. P.:

	Dose		Dose
Fluidextractum Aconiti	0.03 mil (½ ♏).	Fluidextractum Buchu	2 mils (30 ♏).
—Gelsemii		—Cascaræ Sagradæ	
—Belladonnæ Radicis		Aromaticum	
—Digitalis		—Ergotæ	
—Nucis Vomicæ	0.05 mil (1 ♏).	—Eucalypti	
—Ipecacuanhæ (expectorant)		—Glycyrrhizæ	
—Cannabis		—Granati	
—Scillæ	0.1 mil (1½ ♏).	—Grindeliæ	
—Veratri Viridis		—Guaranæ	
—Lobeliæ	0.15 mil (2½ ♏).	—Hydrastis	
—Colchici Seminis		—Pilocarpi	
—Hyoscyami	0.2 mil (3 ♏).	—Rosæ	
—Podophylli	0.5 mil (8 ♏).	—Sarsaparillæ	
—Aromaticum	1 mil (15 ♏).	— —Compositum	
—Aurantii Amari		—Sennæ	
—Cimicifugæ		—Stillingiæ	
—Cinchonæ		—Sumbul	
—Eriodictyi		—Uvæ Ursi	
—Frangulæ		—Viburni Prunifolii	
—Gentianæ		—Xanthoxyli	
—Cascaræ Sagradæ		—Aspidospermatis	4 mils (1 fl. dr.).
—Rhei		—Spigeliæ	
—Sabal		—Taraxaci	10 mils (2½ fl. dr.).
—Senegæ		—Tritici	
—Zingiberis		—Staphisagriæ	externally.

Glycerita (Glycerites).—Solutions of drugs in glycerin. They are all liquid preparations, largely used for external application. In the U. S. P. are five:

	Dose		Dose
Glyceritum Phenolis	0.3 mil (5 ♏).	Glyceritum Amyli	externally.
—Acidi Tannici	2 mils (30 ♏).	—Boroglycerini	externally.
—Hydrastis	2 mils (30 ♏).		

Infusa (Infusions).—Infusions must be *freshly* made from drugs, and, when their strength is not otherwise directed, they are to be prepared by the following, general method. The drug, 50; introduced into a suitable vessel provided with a cover; boiling water, 1000; is poured upon it and the vessel tightly covered and allowed to stand for half an hour. It is then strained with expression, and enough water passed through the strainer to make the infusion measure 1000. If the activity of the drug is affected by heat, cold water only should be used. The strength of infusions of potent or very active drugs should be specially directed by the physician.

The infusions of the U. S. P. are:

	Dose		Dose.
Infusum Digitalis	4 mils (1 fl. dr.).	Infusum Sennæ Compositum	120 mils (4 fl. oz.).

Linimenta (Liniments).—Solutions or mixtures for external application, liquid, at least upon application. All of them are intended to be rubbed into the skin except Linimentum Calcis. Those in the U. S. P. are:

Linimentum Ammoniæ	Ammonia water, and sesame oil.
—Belladonnæ	Fluidextract of belladonna root and camphor.
—Calcis	Lime water and linseed oil.
—Camphoræ	Camphor and cotton seed oil.
—Chloroformi	Chloroform and soap liniment.
—Saponis	Soap, camphor, oil of rosemary, alcohol, and water.
——Mollis	Soft soap, oil of lavender and alcohol.
—Terebinthinæ	Rosin cerate and oil of turpentine.

Liquores (Liquors).—Solutions of chemical substances in a menstruum consisting chiefly or wholly of water. The following are in the U. S. P.

	Dose		Dose
Liquor Arseni et Hydrargyri Iodidi	0.1 mil (1½ ♏)	Liquor Hydrogenii Dioxidi	4 mils (1 fl. dr.).
—Ferri Chloridi	0.1 mil (1½ ♏)	—Ammonii Acetatis	15 mils (4 fl. dr.).
—Acidi Arsenosi	0.1 mil (1½ ♏)	—Calcis	15 mils (4 fl. dr.).
—Ferri Subsulphatis	0.2 mil (3 ♏).	—Ferri et Ammonii Acetatis	15 mils (4 fl. dr.).
—Iodi Compositus	0.2 mil (3 ♏).	—Potassii Citratis	15 mils (4 fl. dr.).
—Potassii Arsenitis	0.2 mil (3 ♏).	—Magnesii Citratis	350 mils (12 fl. oz.).
—Sodii Arsenatis	0.2 mil (3 ♏).	—Sodii Chloridi Physiologicus	indeterminate.
—Glycerophosphatis	0.35 mil (6 ♏).		
—Potassi Hydroxidi	1 mil (15 ♏).		
—Hypophysis	1 mil (15 ♏).		
—Sodii Hydroxidi	1 mil (15 ♏).		

The following are not used internally:

Liquor Cresolis Compositus	Liquor Plumbi Subacetatis.
—Ferri Tersulphatis.	——Subacetatis Dilutus.
—Formaldehydi.	—Sodæ Chlorinatæ.
	—Zinci Chloridi.

Magma.—A suspension of a finely divided insoluble substance in water, the substance generally being produced by chemical reaction during the manufacture. These are often known as Milks.

The U. S. P. contains two:

	Dose
Magma Bismuthi	4 mils (1 fl. dr.).
—Magnesiæ	10 mils (2½ fl. dr.).

Massæ (Masses).—Pill-masses intended for preservation in bulk until required for use. They are often employed as constituents of other pill-masses. The Massa Ferri Carbonatis is not of sufficiently firm consistence to admit of being rolled into pills which will retain their spherical shape without the addition of absorbents, except when freshly made in warm weather. Two are official in the U. S. P.:

	Dose
Massa Ferri Carbonatis —Hydrargyri	0.250 gm. = 250 milligm. (4 gr.).

Mellita (Honeys).—Mixtures of medicinal substances with clarified honey. The U. S. P. contains two, one of these being simply honey purified.

	Dose		Dose
Mel Rosæ	4 mils (1 fl. dr.).	Mel Depuratum	indeterminate.

Misturæ (Mixtures).—Liquid preparations of insoluble, suspended, active substances, or solutions containing more than one liquid of therapeutic activity. The mixture is usually flavored, and is intended for internal administration. The U. S. P. contains two:

	Dose		Dose
Mistura Glycyrrhizæ Composita	10 mils (2½ fl. dr.).	Mistura Cretæ	15 mils (4 fl. dr.).

Mucilagines (Mucilages).—Adhesive liquids or jelly-like preparations, consisting of gum or starch dissolved in or fully charged with water. The U. S. P. contains two:

	Dose		Dose
Mucilago Acaciæ	15 mils (4 fl. dr.).	Mucilago Tragacanthæ	indeterminate.

Oleata.—Oleates are solutions of solids in oleic acid, intended for external application. The U. S. P. contains one:

Oleatum Hydrargyri (25 per cent. of yellow mercuric oxide).

Olea.—There are many oils, all obtained by maceration and distillation or by expression. Those in the U. S. P. are:

	Dose
Oleum Sinapis Volatile	0.008 mil (⅛ ♏).
—Amygdalæ Amaræ	0.03 mil (½ ♏).
—Tiglii	0.05 mil (1 ♏).
—Anisi	0.2 mil (3 ♏).
—Aurantii	
—Cari	
—Caryophylli	
—Cassiæ	
—Chenopodii	
—Coriandri	
—Fœniculi	
—Juniperi	
—Lavandulæ	
—Limonis	
—Menthæ Piperitæ	
— —Viridis	
—Myristicæ	
—Picis Liquidæ Rectificatum	
—Pimentæ	
—Rosmarini	

	Dose
Oleum Sassafras	0.2 mil (3 ♏).
—Thymi	
—Terebinthinæ Rectificatum	0.3 mil (5 ♏).
—Cajuputi	0.5 mil (8 ♏).
—Cubebæ	
—Eucalypti	
—Santali	
—Morrhuæ	10 mils (2½ fl. dr.).
—Ricini	
—Gossypii Seminis	30 mils (1 fl. oz.).
—Lini	
—Olivæ	
—Amygdalæ Expressum	indeterminate.
—Sesami	
—Cadinum	externally.
—Pini Pumilionis	
—Terebinthinæ	
—Theobromatis	

Pilulæ (Pills).—Solid bodies, usually spherical or oval, containing medicinal agents, and intended to be swallowed whole. A mass of the consistence of firm clay is made by beating medicaments together in a mortar, and by means of a machine this is divided up and rolled into pills. In order to prevent their being tasted, they are usually varnished, gilded, or sugar-coated. Unless the constituents are very heavy, each pill should not exceed 0.30 gm. (5 gr.) in weight, and the smaller they are the better. Soap, mucilage of acacia or tragacanth, and confection of rose are common excipients for pills. Glycerin is often added, as it attracts moisture and prevents the pill from getting hard, but pills made of it alone are too soft. Soap is useful for creosote, resinous substances, and for volatile oils if calcium phosphate and bread crumb be added. Licorice powder is a good absorbent. The best general excipient is composed of benzoic acid, 1; acacia, 90; glycerin, 480; glucose (syrupy), 1920. Kaolin is the best excipient for substances, as potassium permangan-

ate, which are decomposed by contact with organic matter. All pills are useless unless so made that they will dissolve in the gastro-intestinal canal. If it is required that they should not be acted upon until they reach the intestine they should be coated with keratin. Pills, except when sugar- or gelatin-coated, are often kept in some powder, as lycopodium, to prevent their sticking together. The pills in the U. S. P. are:

	Dose		Dose
Pilulæ Phosphori	1 pill.	Pilulæ Ferri Carbonatis.	2 pills.
—Aloes	2 pills.	— —Iodidi	
—Asafœtidæ		—Rhei Compositæ	
—Catharticæ Compositæ			

Pulveres (Powders).—Preparations consisting of finely powdered drugs, or (compound powders) mixtures of the same, and frequently consisting in part of a suitable diluent or excipient. The best diluent for powders is sugar of milk, because of its hardness and comparative insolubility. The powders of the U. S. P. are:

	Dose		Dose
Pulvis Ipecacuanhæ et Opii	0.500 gm. = 500 milligm. (8 gr.)	Pulvis Jalapæ Compositus	2 gm. (30 gr.).
—Aromaticus	1 gm. (15 gr.).	—Rhei Compositus	
—Cretæ Compositus	2 gm. (30 gr.).	—Glycyrrhizæ Compositus	4 gm. (60 gr.).

Also Pulvis Effervescens Compositus (Seidlitz Powder), *see* p. 63. Pulvis Ipecacuanhæ et Opii is practically a trituration.

Spiritus (Spirits).—Solutions of volatile substances in alcohol or diluted alcohol. The spirits of the U. S. P. are:

By solution:	Dose		Dose
Spiritus Glycerylis Nitratis	0.05 mil (1 ♏).	Spiritus Juniperi Compositus	10 mils (2½ fl. dr.).
—Amygdalæ Amaræ	0.5 mil (8 ♏).	—Aurantii Compositus	as vehicle.
—Camphoræ	1 mil (15 ♏).	By solution with maceration:	
—Ammoniæ Aromaticus	2 mils (30 ♏).	Spiritus Menthæ Piperitæ	2 mils (30 ♏).
—Anisi		— —Viridis	
—Chloroformi		By chemical reaction:	
—Cinnamomi		Spiritus Ætheris Nitrosis	2 mils (30 ♏).
—Juniperi			
—Lavandulæ			
—Ætheris	4 mils (1 fl. dr.).		

Suppositoria (Suppositories).—These are solid bodies of various weights and shapes, adapted for introduction into the different orifices of the human body, and melting or softening at body heat. The vehicles usually employed are: Oil of theobroma, glycerinated gelatin or sodium stearate. Rectal suppositories should be cone-

shaped, and when made from oil of theobroma should weigh about 2 gm. Urethral suppositories (bougies) should be pencil-shaped, pointed at one extremity, and either 7 cm. in length, weighing about 2 gm. or 14 cm. in length, weighing about 4 gm., when made with glycerinated gelatin; if prepared with oil of theobroma, they should weigh about one-half the above quantities. Vaginal suppositories should be globular or oviform in shape and weigh about 10 gm. if made with glycerinated gelatin, and about 4 gm. if made with oil of theobroma. One only is official in U. S. P.

Suppositoria Glycerinci: base, stearic acid.

Syrupi (Syrups).—Liquid preparations of drugs consisting chiefly of a concentrated aqueous solution of sugar. There are in the U. S. P.:

	Dose		Dose
Syrupus Ferri Iodidi....	1 mil (15 ♏).	—Syrupus Hypophosphitum	10 mils (2½ fl. dr.).
—Ipecacuanhæ (expectorant.		—Lactucarii.....	
—Ipecacuanhæ (emetic).	15 mils (4 fl. dr.).	—Rhei.....	
—Scillæ.....	2 mils (30 ♏).	— —Aromaticus.....	
— —Compositus.....		—Sarsaparillæ Compositus.....	15 mils (4 fl. dr.).
—Acidi Hydriodici.....	4 mils (1 fl. dr.).	—Tolutanus.....	
—Picis Liquidæ.....		—Zingiberis.....	
—Pruni Virginianæ.....		Syrupus.....	as vehicle.
—Senegæ.....		—Acaciæ.....	
—Sennæ.....		—Acidi Citrici.....	as flavoring.
—Calcii Lactophosphatis	10 mils (2½ fl. dr.).	—Aurantii.....	
		— —Florum.....	

Tincturæ.—Tinctures are alcoholic preparations made by extracting the valuable principles of drugs by the use of appropriate menstrua or solvents. Tincture of ferric chloride and tincture of iodine are exceptional, not being made by extraction but they are alcoholic solutions of chemical substances. Tinctures of potent drugs are of 10 per cent. strength; others vary in proportion of drug to finished tincture. Tinctures are prepared either (*a*) by percolation, or (*b*) by maceration; some, however, require special manipulation in order to obtain satisfactory results. When it has been possible or desirable to standardize the tinctures, this is done and the rubric and assay will be found in the U. S. P.

Tinctures containing only one active substance are simple. The rest are compound; *e.g.*, Tinctura Gentianæ Composita. Some are compound, although this is not expressed in their name; *e.g.*, Tinctura Aloes.

The tinctures of the U. S. P. are:

	Dose		Dose
Tinctura Iodi	0.1 mil (1½ ♏)	Tinctura Hyoscyami	2 mil (30 ♏).
—Cantharidis		—Lactucarii	
—Gelsemii	0.25 mil (4 ♏).	—Lavandulæ Composita	
—Aconiti	0.3 mil (5 ♏).	—Quassiæ	
—Capsici	0.5 mil (8 ♏).	—Rhei Aromatica	
—Digitalis		—Tolutana	
—Ferri Chloridi		—Valerianæ Ammoniata	
—Nucis Vomicæ		—Zingiberis	
—Opii		—Aurantii Amari	4 mils (1 fl. dr.).
— —Deodorati		— —Dulcis	
—Stramonii		—Calumbæ	
—Strophanthi		—Cardamomi Composita	
—Veratri Viridis		—Cinchonæ	
—Belladonnæ Foliorum	0.75 mil (12 ♏).	— —Composita	
—Cannabis		—Gambir Composita	
—Arnicæ		—Gentianæ Composita	
—Asafœtidæ		—Guaiaci	
—Benzoini	1 mil (15 ♏).	—Hydrastis	
—Lobeliæ		—Kino	
—Myrrhæ		—Moschi	
—Physostigmatis		—Opii Camphorata	
—Sanguinariæ		—Rhei	
—Scillæ	2 mils (30 ♏).	—Valerianæ	
—Aloes		—Pyrethri	externally.
—Benzoini Composita		—Limonis Corticis	flavoring.
—Cardamomi			
—Cinnamomi			
—Colchici Seminis			
—Guaiaci Ammoniata			

Toxitabellæ (Poison Tablets).—These are tablets of an angular shape (not discoid) each having the word "POISON" and the skull and crossbones design distinctly stamped upon it. The purpose of these tablets, distinctive in shade and marking, is to diminish the occurrence of poisoning from their accidental ingestion. The U. S. P. contains one:

Toxitabellæ Hydrargyri Chloridi Corrosivi.....externally.

Triturations.—Triturations are made by reducing the drug, 10; to fine powder, and triturating with sugar of milk, 90; the latter being added in small portions from time to time. The U. S. P. contains one:

	Dose
Trituratio Elaterini	0.030 gm. = 30 milligm. (½ gr.).

Trochisci (Troches).—Solid preparations, usually in flattened form, consisting of one or more medicinal substances mixed with sugar or extract of licorice and held in form by the addition of mucilage generally of tragacanth. These are official in the U. S. P.:

Trochisci Acidi Tannici.	Trochisci Cubebæ.	Trochisci Sodii Bicarbonates.
—Ammonii Chloridi.	—Potassii Chloratis.	

Unguenta (Ointments).—Unctuous preparations, either soft or solid at ordinary temperatures, but liquid upon being placed upon the skin. They are generally spread over the skin, or may be rubbed into it, and they are intended for external use only. The basis is either benzoinated lard, expressed oil of almond, glycerin, wax, prepared suet, spermaceti, hydrous wool-fat, petrolatum or paraffin. When it is required that the active ingredient shall be absorbed, benzoinated lard, which melts at about the temperature of the body, or hydrous wool-fat, is the best basis; when the ointment is required for open wounds, paraffin is a good basis, as it softens only a little at the temperature of the body. In hot countries, if the ointment would otherwise be too soft, the basis may be replaced by prepared suet, or white or yellow wax. Benzoinated lard is generally used to prevent decomposition. The following are official in the U. S. P.:

Unguentum.	Unguentum Hydrargyri.	Unguentum Phenolis.
—Acidi Borici.	— —Ammoniati.	—Picis Liquidæ.
— —Tannici.	— —Dilutum.	—Stramonii.
—Aquæ Rosæ.	— —Nitratis.	—Sulphuris.
—Belladonnæ.	— —Oxidi Flavi.	—Zinci Oxidi.
—Chrysarobini.	—Iodi.	
—Diachylon.	—Iodoformi.	
—Gallæ.		

The following preparations not occurring in the U. S. P. are used:

Abstracta (Abstracts).—Solid, dry, powdered extracts of double the strength of the crude drug. They are prepared by spontaneous evaporation of a tincture at a low temperature, mixing with it enough sugar of milk to make the product weigh one-half of the original weight of the drug, and then reducing it to a fine powder.

Bougies.—Solid cylinders impregnated with various drugs, and used for introduction into the urethra, uterus, or nose. They are made either of gelatin (to be dipped in warm water before use) or of oil of theobroma (to be dipped in oil before use).

Cachets (Wafers).—These are made of starch paper and consist of two watch-glass shaped halves, enclosing the drug, which adhere when moistened. The cachet is swallowed, and thus nauseous drugs are not tasted.

Capsules.—These, usually made of gelatin, are also used for enclosing medicines so that they shall not be tasted, and they may be used for both solid and liquid substances. They are either soft and elastic or hard. The "empty capsule" is of the hard form and is made in two parts, the body to be filled when required for use, and the cap to fit tightly over it when filled. Pills, cachets and

capsules should be immediately followed by enough water so that they are easily swallowed.

Cataplasmata (Poultices).—Soft, pasty masses used as a medium for the external and local application of a moist heat, with or without the addition of active medicaments. Any bland substance, which will retain its heat and moisture for a long time, is applicable for this purpose, a little oil or glycerin being often added to prevent caking. The substances chiefly used are kaolin, linseed, elm bark, bran or oatmeal.

To make a poultice properly, the bowl in which it is mixed, the water, and the spatula for mixing and spreading, the flannel or cheese-cloth on which it is laid, must all be as hot as possible. The material should be added gradually to the boiling water, which is continually stirred. It should not be spread so thick as to make it inconveniently heavy.

Chartæ (Papers).—Non-absorbent papers coated with plaster-like preparations and used like plasters.

Cigarettes.—The drug replaces the tobacco of an ordinary cigarette.

Clysters.—Another name for Enemata.

Collunaria.—Fluids used as nasal douches. This term is rarely used in the United States.

Collyria.—Fluids used as eye washes.

Confectiones (Confections).—*Synonyms.*—Electuaries. In England, Boluses or Conserves. Permanent pasty preparations of powdered drugs thoroughly triturated with syrup or honey.

Cremora.—(Obsolete in the United States.) Creams are preparations having glycerin, petrolatum, or some such substance as a basis, and used for external application.

Enemata (Enemas).—Liquids intended for injection into the rectum and designed to act medicinally, to evacuate the bowel mechanically, or to serve as nutrients. When their object is to empty the bowel, they are usually large in bulk, 300 to 600 mils (10 to 20 fl. oz.); when it is wished that they should be retained, they are small, 60 to 150 mils (2 to 5 fl. oz.), and after injection a towel may be pressed against the anus. Mucilage, made with starch, is a good basis.

Essentiæ (Essences).—Preparations corresponding to Spiritus, U. S. P., but of 20 per cent. strength.

Fomenta.—Fomentations consist of flannels wrung out in hot water, to which drugs may or may not have been added.

Gargarismata (Gargles).—These are fluid preparations for gargling.

Granules.—The designation for small pills.

Guttæ (Drops).—In England this term is used to designate liquid preparations to be dropped into the eye.

Haustus (Draught).—This term is used when only a single dose of a fluid preparation is required.

Injectiones (Injections).—These are of two kinds, Rectal (*see* Enemata), and Hypodermatic. The latter are highly concentrated solutions of drugs intended for use by means of a hypodermatic syringe.

Insufflationes.—Powdered medicines or medicated powders designed for blowing into the nares, larynx or throat.

Lamellæ.—Small thin discs made with gelatin and glycerin, and used to place into the eye. They each weigh 0.0013 gm. ($\frac{1}{50}$ of a grain).

Lanolinum.—This is an ointment having hydrous wool-fat as a basis.

Linctus.—(Never used in the United States.) A sweet mixture of a thick, syrupy consistence. It is to be swallowed slowly, being retained some time in the mouth.

Lotiones (Lotions).—Liquid, usually aqueous, preparations for external use, commonly applied upon lint or muslin.

Mollinum.—An ointment having for its basis mollin, a superfatted soap. It is readily absorbed, and also readily washed off with water.

Nebulæ (Sprays).—Solutions sprayed into the throat or nose by means of an atomizer.

Oxymellita.—Mellita containing acetic acid.

Paste.—A preparation to be applied as an ointment.

Pastilli (Pastils).—A name often applied to troches, and in England limited to those having glyco-gelatin as a basis.

Perles.—This is another name for small pills.

Pessus.—Pessaries are solid preparations made like suppositories for introduction into the vagina. This term is rarely used in the United States.

Pigmenta (Paints).—Liquid preparations adapted for painting on the skin, throat, etc.

Succi (Juices).—Expressed vegetable juices preserved by the addition of a definite proportion of alcohol.

Tabellæ.—(Tablets or Tabloids, the latter of British usage.) Solid, disc-like or lenticular bodies made by compression. "Tablet triturates" are composed of drugs which have been triturated before compression. They are very popular, but are often useless, for they may be so hard and insoluble that they are found in the fæces quite unaltered. Tablets should therefore always be prescribed extemporaneously and freshly made.

Vapores.—Liquid preparations intended for administration by inhalation in form of vapor.

Vaselinum.—This term in England is applied to an ointment of which the base is vaseline.

Vina.—Wines are practically weak tinctures, the drug being extracted with white wine, containing not less than 7 per cent. nor more than 12 per cent. by weight of absolute alcohol.

PRESCRIBING

The more complex **prescriptions** consist of— (1) The Basis, or principal active ingredient (*curare*). (2) The Adjuvans, or that which assists its action (*cito*). (3) The Corrigens, or that which corrects its operation (*tuto*). (4) The Constituens, vehicle, or excipient, or that which imparts an agreeable form (*jucunde*).

Thus, the object of every prescription is to cure quickly, safely and pleasantly. For example, in Pilula Rhei Composita the rhubarb is the basis, the aloes and myrrh form the adjuvans, and the oil of peppermint is the corrigens to prevent the griping. In Mistura Cretæ the cinnamon water is the vehicle. Many drugs

do not require anything to assist their action or correct their operation. The scientific physician usually prefers to administer the remedies separately, in order to more accurately observe their effect, and as well to discontinue, or change the dose of any one which may be necessary.

Incompatibility of ingredients should be particularly avoided in prescriptions. There are three kinds of incompatibility:

(*a*) *Chemical Incompatibility; e.g.*, **Glucosides** should not be ordered with free acids, which decompose them; nor **Alkaloids** or **Alkaloidal Salts** with alkalies, alkaline salts, tannic acid, iodides, or bromides, for they precipitate them.

Examples of chemical incompatibility are the prescribing of (1) tannic acid or substances containing it with alkaloids or metallic salts, especially those of iron (2) vinegars or syrups containing acetic acid prescribed with carbonates lead to the evolution of carbon dioxide; (3) strychnine sulphate is decomposed by potassium bromide, and strychnine is precipitated; (4) hydrated chloral and alkalies form chloroform; (5) quinine sulphate and potassium acetate together cause a voluminous precipitate of quinine acetate; (6) lime water with mercury salts (this incompatibility is intentional in Lotio Nigra and Lotio Flava) precipitates mercuric oxides; it decomposes carbonates and bicarbonates of alkalies; it precipitates solutions of quinine and morphine salts; (7) corrosive mercuric chloride is incompatible with most substances.

With the following drugs it is **particularly difficult to avoid chemical incompatibility.**

Corrosive Mercuric Chloride (especially).	Potassium Permanganate.
Antipyrine.	Potassium Acetate.
Chlorine in solution.	Nitrites.
Liquid preparations of Iron.	Tannic Acid.
Lead salts.	Gallic Acid.
Zinc salts.	Diluted Hydrocyanic Acid.
Silver salts.	Mineral Acids.
Iodine and the Iodides.	Solution of Potassium Hydroxide.
All Bromides.	Quinine Sulphate.
	Tincture of Guaiac.

Substances rich in oxygen, as chlorates, iodates, permanganates, picrates, nitrates and bichromates should **not** be mixed **with readily oxidizable substances,** such as charcoal, sulphur, iodine, phenol, glycerin, turpentine, and organic compounds generally, for explosive compounds are very liable to be formed.

Poisonous compounds may be formed by the admixture of substances in solution: *e.g.*, potassium chlorate and the syrup of ferrous iodide liberate iodine; diluted hydrocyanic acid and calomel form mercuric cyanide; potassium chlorate and potassium iodide form, at the temperature of the body, a poisonous compound, probably potassium iodate. Fatal results have been known to occur from the use of prescriptions thus carelessly made.

If, in a mixture, incompatibles are inevitable, they should both be diluted with

the vehicle before they are added to each other. The careful prescriber will avoid combining any of the above incompatible substances.

The following table, by Potter (Materia Medica, Pharmacy and Therapeutics 12th Ed., p. 523) shows the most important instances of solutions which mutually precipitate each other. The letter "P" means "forms a precipitate with."

Solutions of	Alkaloidal Solutions (generally)	Metallic Solutions (generally)	Solutions of Lead or Silver Salts	Solutions of Calcium Salts	Solutions of Magnesium Salts	Solutions of Albumin or Gelatin
Alkalies	P	P	P	P	P	—
Tannic acid	P	P	P	—	—	P
Carbonic acid and Carbonates	P	P	P	P	P	—
Sulphuric acid and Sulphates	—	—	P	P	—	—
Phosphoric acid and Phosphates	P	P	P	P	P	—
Boric acid and Borates	P	P	P	—	—	—
Hydrochloric acid and Chlorides	—	—	P	—	—	—
Hydrobromic acid and Bromides	—	—	P	—	—	—
Hydriodic acid and Iodides	P	—	P	—	—	—
Sulphides	—	P	P	—	—	—
Arsenical Preparations	—	P	P	—	—	—
Albumin	—	P	P	—	—	—

(*b*) *Physical Incompatibility.*—This occurs when the mixture of the substances will not form a clear solution; *e.g.*, insoluble powders and oils will not mix with water, the addition of which, to some spirits and all resinous tinctures, and to fluidextract of male fern causes a precipitate; if an acid mixture is flavored with licorice, the acid precipitates glycyrrhizin; an alcoholic solution added to chloral hydrate causes all the chloral to rise to the top.

In such cases the aqueous solution may be **thickened** so that the precipitate is suspended in it to form an emulsion, but even then the mixture must be shaken before a dose is taken. **Mucilage of acacia,** freshly made, is the best emulsifying agent. The substances incompatible with it are mentioned under Acacia. It should be made perfectly fresh and the addition of a little almond oil improves its appearance.

1 pt. of most fixed oils requires of acacia ¾ pt., water 1 pt.

1 pt. of balsam of Peru requires of acacia 2 pt., water 1½ pt.

1 pt. of turpentine requires of acacia 1 pt., water 1 pt.

Tragacanth, because its preparations keep better, is often used to form an emulsion or a suspension, and sometimes yolk of egg or milk is employed. **Solution of Potassium Hydroxide** greatly facilitates the admixture of fixed oils and water, although it often acts chemically on the ingredients of the prescription. Tincture of senega (not official) aids the emulsification of any oil, even in small quantities, 0.60 mils (10 ♏); being sufficient for 30 mils (1 fl. oz.), of a fixed oil. Magnesium carbonate is employed to aid the diffusion of an oil in water through

which air is to be inhaled. Resinous tinctures require an emulsifying agent; an equal part of mucilage of acacia is the best.

(*c*) *Pharmacological Incompatibility; e.g.*, the combination of purgatives with astringents which check peristalsis. Sometimes this is intentional, as in the addition of atropine to a hypodermatic solution of morphine.

After the description of each drug those substances which are incompatible with it will be enumerated.

THE PRESCRIPTION

The details of a prescription should be written in the following order:

The *first* part is the *Superscription*, which is the sign ℞, an abbreviation for Recipe "Take."

The *second* part is the *Inscription*, consisting of the names of the drugs in the genitive case (the vehicle in the accusative if *ad* is used with it), and their doses in the accusative.

The *third* part is the *Subscription*, that is to say, the directions to the dispenser. This in the United States and most other countries is written in Latin, but in France it is in the language of the country.

The *fourth* part is the *Signature*, namely, the directions to the patient (from the Latin "*Signetur*," let it be labelled). This is written in English.

The *fifth* part consists of the physician's name or initials at the bottom on the right, the patient's name at the bottom on the left, and under it the date; thus:

Superscription.—℞.

Inscription.—Tincturæ Ferri Chloridi, 12 mils; fl. ʒ iij (*basis*).
Quininæ Hydrochloridi, 2 gm.; gr. xxx (*adjuvans*).
Magnesii Sulphatis, 60 gm.; ʒ ij (*corrigens*).
Glycerini, 60 mils; fl. ʒ ij (*corrigens*).
Aquam, ad 240 mils; fl. ʒ viij (*excipient*).

Subscription.—Fiat mistura.

Signature.—Take one tablespoonful three times daily, two hours after meals.
A. B. C. (physician's initials).

William Smith, Esq. (patient's name).
29th August, 1916 (date).

The Federal narcotic laws require that prescriptions written for narcotic and habit-forming drugs shall contain additional information: the date upon which the prescription was written, the patient's name, residence and age, the residence, registration number, office hours and signature of the prescriber, and as well as that a record be made of the prescription and kept for at least two years. Since there are many and conflicting laws every prescriber should familiarize himself with the National, and local State and Municipal laws upon this subject.

In countries where the metric system is generally employed the quantities, either of fluids or solids, are expressed in grammes, so that the abbreviation is omitted; 60 meaning 60 gm. or 60 c.c. as the substance may be solid or liquid. In the United States and Great Britain (Pharmacopœia, 1914) mils should be used instead of c.c.

Abbreviations.—Although abbreviations are objectionable, yet this prescription could be written thus:

℞. Tinct. Ferr. Chlor., 12 mils; fl. ℥ iij.
Quin. Hydrochl., 2 gm.; gr. xxx.
Mag. Sulph., 60 gm.; ℥ ij.
Glycer., 60 mils; fl. ℥ ij.
Aq., ad 240 mils; fl. ℥ viij.
F. m.

S. Take one tablespoonful thrice daily, two hours after meals.
William Smith, Esq. A. B. C.
29th August, 1916.

S, ss. and *fs.* are abbreviations for *semi*, a half, and *āā* for *ana*, of each.

Ad.—The prescriber should be careful in deciding whether or not to use this word before the vehicle. If it had been left out in the prescriptions given above, the bulk of the mixture would have been nearly 315 mils (10½ fluid ounces) and the amount of the ingredients in each dose would have been less than was intended.

The following is a prescription for a pill:

℞. Extracti Nucis Vomicæ, 0.015 gm.; gr. ¼.
Aloini, 0.03 gm.; gr. ss.
Hydrargyri Chloridi Mitis, 0.06 gm.; gr. j.
Extractum Hyoscyami, ad 0.30 gm.; gr. v.
Fiat Pilula. Mitte 24.

S. Take one immediately before dinner every evening.
William Smith, Esq. A. B. C.
29th August, 1916.

It will be observed that the quantities in the prescription are for one pill only and the apothecary is directed to send 24. Often, however, the prescription is written with the quantity of each ingredient necessary to make the full number of pills. Thus:

℞. Extracti Nucis Vomicæ, 0.36 gm.; gr. vj.
Aloini, 0.75 gm.; gr. xij.
Hydrargyri Chloridi Mitis, 1.50 gm.; gr. xxiv.
Extractum Hyoscyami, ad 8 gm.; gr. cxx.
Fiant Pilulæ. Mitte 24.

S. Take one immediately before dinner every evening.
William Smith, Esq. A. B. C.
29th August, 1916.

Prescriptions for powders are also written in either form.

The medicine may be prescribed as a pill when it is required that the patient shall carry it about with him, when only a small dose is needed, when it is desirable that it shall act slowly, when it is required to act on the lower bowel, when it is insoluble or nauseous, or when it is difficult to prescribe in the liquid form.

Oils, and volatile, deliquescent or bulky substances should not be prescribed as pills, as they require much solid excipient; nor should pills be used for substances required to act immediately. Insoluble or very disagreeable powders are often given in *cachets*.

Abbreviations should be employed as little as possible. Serious mistakes have happened because the abbreviations have been ambiguous. The following are especially to be avoided:

Acid. Hydroc.	(may be Acidum Hydrochloricum or Acidum Hydrocyanicum).
Ex. Col.	(may be Extractum Colchici Cormi or Extractum Colocynthidis).
Hyd. Chlor.	(may be Calomel, Corrosive Sublimate or Hydrated Chloral).
Hyd.	(may be Hydrargyrum, Hydras, Hydriodas, Hydrochloridum, Hydrochloras or Hydrocyanicus).
Sulph.	(may be Sulphide, Sulphate, or Sulphite).

The present Pharmacopœia (U. S. P. IX) gives with each preparation its official abbreviation.

The following Latin phrases with their abbreviations are commonly used in the writing of prescriptions:

āā.	Ana	of each.
Ad.	Adde	add.
Adhib.	Adhibendus	to be administered.
Admov.	Admove	apply.
Ad lib.	Ad libitum	to the desired amount.
Ad sat.	Ad saturandum	to saturation.
Ad us.	Ad usum	according to custom.
Æq.	Æquales	equal.
Agit.	Agitetur	let it be shaken.
Alt. hor.	Alternis horis	every other hour.
Ampul.	Ampulla	a large bottle.
Aq.	Aqua	water.
Aq. bull.	Aqua bulliens	boiling water.
Aq. dest.	Aqua destillata	distilled water.
Aq. ferv.	Aqua fervens	hot water.
Aq. fluv.	Aqua fluviatilis	river water.
Aq. font.	Aqua fontis	spring water.
Aq. pluv.	Aqua pluvialis	rain water.
Bene	Bene	well.
Bib.	Bibe	drink.
Bis ind.	Bis indies	twice a day.
Bis in 7 d.	Bis in septem diebus	twice a week.
Bol.	Bolus	a large pill.
Bull.	Bulliat	let it boil.
C.	Cum	with.
Calef.	Calefactus	warmed.

Cap.	Capiat	let him take.
Cap.	Capsula	a capsule.
Chart.	Charta	a paper.
Chartul.	Chartula	a small paper.
Cib.	Cibus	food.
Cito disp.	Cito dispensetur	let it be dispensed quickly.
C. m.	Cras mane	to-morrow morning.
C. m. s.	Cras mane sumendus	to be taken to-morrow morning
C. n.	Cras nocte	to-morrow night.
Cochl.	Cochleare	a spoonful.
Cochl. ampl.	Cochleare amplum	a table-spoonful.
Cochl. mag.	Cochleare magnum	a table-spoonful.
Cochl. mod.	Cochleare modicum	a dessert-spoonful.
Cochl. parv.	Cochleare parvum	a teaspoonful.
Col.	Cola	strain.
Collun.	Collunarium	a nasal wash.
Collut.	Collutorium	a mouth wash.
Collyr.	Collyrium	an eye wash.
Cont.	Contere	rub together.
Contin.	Continueter	let it be continued.
Cras.	Cras	to-morrow.
Cuj.	Cujus	of which.
C. v.	Cras vespere	to-morrow evening.
Cyath.	Cyathus	a glassful.
Cyath. vinos.	Cyathus vinosus	a wine glassful.
D.—d.	Da	give.
D.	Dosis	a dose.
Deaur.	Deaurentur	let them (the pills) be gilded.
Dec.	Decanta	decant.
D. d. in d.	De die in diem	from day to day.
Det.	Detur	let it be given.
Dieb. alt.	Diebus alternis	on alternate days.
Dim.	Dimidius	one-half.
Div.	Divide	divided.
D. in p. æ.	Divide in partes æquales	divided into equal parts.
Exhib.	Exhibiatur	let it be given.
F. or ft.	Fiat	let it be made.
F. h.	Fiat haustus	make a draught.
F. m.	Fiat mistura	make a mixture.
F. pil.	Fiat pilula	make a pill.
Form.	Formula	a prescription.
F. s. a.	Fac secundum artem	make according to art.
Garg.	Gargarisma	a gargle.
Gtt.	Gutta or guttæ	drop or drops.
Habt.	Habeat	let him have.
Hor. decub.	Horâ decubitus	at bedtime.
Hor. intermed.	Horis intermediis	at intermediate hours.

H. s.	Horâ somni	at bedtime.
Ill.	Illico	immediately.
Imp.	Impone	apply.
Ind.	Indies	daily.
Instar	Instar	the size of.
Involv gelat.	Involve gelatino	coat with gelatin.
Lat. dol.	Lateri dolenti	to the painful side.
Len.	Lenitur	easily.
Len. ter.	Lenitur terendo	by rubbing gently.
Mane.	Mane	in the morning.
Mane primo	Mane primo	early in the morning.
Mic. pan.	Mica panis	bread crumb.
Mit.	Mitte	send.
Mod. dict.	Modo dictu	in the manner directed.
Mod. præscript.	Modo præscripto	in the manner prescribed.
Non repetat.	Non repetatur	let it not be repeated.
O. m.	Omni mane	every morning.
Omn. bih.	Omni bihorâ	every two hours.
Omn. hor.	Omni horâ	every hour.
O. n.	Omni nocte	every night.
P. or pt.	Perstetur	continue.
Part. æq.	Partes æquales	equal parts.
Penicil. cam.	Penicillum camelinum	a camel's hair pencil.
Pil.	Pilula	a pill.
P. r. n.	Pro re natâ	when required.
Q. hor.	Quâquâ horâ	every hour.
Q. l.	Quantum libet	as much as is requisite.
Q. s.	Quantum sufficit	a sufficient quantity.
Q. v.	Quantum volueris	at will.
R.	Recipe	take.
Red. in pulv.	Redactus in pulverem	reduced to powder.
Rep.	Repetatur	let it be repeated.
Sat.	Satis	sufficient.
Semel	Semel	once.
Semi h.	Sèmi hora	half an hour.
Sesq. h.	Sesqui hora	an hour and a half.
Sic.	Sicetur	let it be dried.
Sin.	Sine	without.
Sing.	Singulorum	of each.
Si op. sit.	Si opus sit	if necessary.
Sum.	Sumat or sumendum	let him take or let it be taken.
T. d.	Ter in die	three times a day.
Ter.	Tere	Rub.
Ter. bene	Tere bene	Rub well.
Trit.	Trituretur	let it be triturated.
Utere	Utere	make use of.
Vehic.	Vehiculum	menstruum.

Ver.	Verus	genuine.
Vesp	Vesper	the evening.

In the United States it is always understood, unless otherwise stated, that the preparations are those directed by the Pharmacopœia.

Dispensing the Prescription.—The dispenser should bear the following rules in mind: (1) Read the prescription through first. (2) Next write the directions, so that they have time to dry. (3) Solution by heat should not be used if more of the salt is ordered than will dissolve in cold water. In such case it must be suspended. (4) With fluids, measure them in such an order that the measuring glass shall be finally rinsed out with vehicle. (5) Use glass scale pans. (6) Clean and put away everything directly after use. (7) If in the slightest doubt, ask the prescriber. (8) If finally the prescription contains any insoluble matter, label "Shake the bottle." (9) If the medicine is very poisonous, label it as such and use a distinctive bottle. (10) If for outward application only, label it as such. (11) In dispensing substances chemically incompatible, if there is any likelihood that the new body formed is dangerous, communicate with the prescriber before dispensing. Should there be no such reason against dispensing the prescription, keep the incompatibles as far apart as possible by diluting each with the vehicle before mixing. (12) Make such records as required by the various laws governing the dispensing of narcotic and habit-forming drugs.

SECTION I. INORGANIC MATERIA MEDICA

DIVISION I: THE NON-METALS

GROUP I

The Halogens: Chlorine, Bromine, Iodine

I. CHLORUM

CHLORUM.—Chlorine. Cl = 35.46.
This gas is not official under its own name.

Preparations

1. **CALX CHLORINATA.**—Chlorinated Lime. Abv.—Calx Chlorin. Chlorinated Calcium Oxide. *Synonym.*—Bleaching powder. A product resulting from the action of Chlorine upon Calcium Hydroxide, and containing not less than 30 per cent. of available Chlorine. It is often improperly called "Chloride of Lime." It may be regarded either as a compound of Calcium Hypochlorite and Chloride, or as one of Lime and Chlorine.

SOURCE.—Pass Chlorine gas over slaked lime. $2Ca(OH)_2+2Cl_2=CaCl_2O_2+CaCl_2+2H_2O$.

CHARACTERS.—A white, or grayish-white, granular powder, having the odor of chlorine. It becomes moist and gradually decomposes on exposure to the air and when in such condition should not be used. *Solubility.*—Partially in water or alcohol. The insoluble portion settles readily when mixed with water. If lumps are present they readily break down.

2. **LIQUOR SODÆ CHLORINATÆ.**—Solution of Chlorinated Soda. Abv.—Liq. Sod. Chlorinat. *Synonym.*—Labarraque's Solution. An aqueous solution of Chlorine compounds of Sodium, containing not less than 2.5 per cent., by weight of available Chlorine.

SOURCE.—A solution of Monohydrated Sodium Carbonate, 70; Chlorinated Lime, 100; in water to 1000.

CHARACTERS.—A clear, pale greenish liquid, having a faint odor of Chlorine and a disagreeable alkaline taste.

For the Therapeutics of Chlorine *see* p. 302.

II. BROMUM

BROMUM.—Bromine. Br = 79.92. This liquid is not official under its own name.

Preparations

1. **AMMONII BROMIDUM.**—Ammonium Bromide. Abv.—Ammon. Brom. $NH_4Br = 97.96$.

It should contain not less than 98.5 per cent. of Ammonium Bromide.

SOURCE.—Made by neutralizing Hydrobromic Acid with Ammonia or Ammonium Carbonate, evaporating and crystallizing. $HBr + NH_4OH = NH_4Br + H_2O$.

CHARACTERS.—Colorless, transparent, prismatic crystals, or a white, crystalline or granular powder; odorless, and of a pungent, saline taste; somewhat hygroscopic. *Solubility.*—In 13 parts of water; in 12 parts of Alcohol; in 0.9 part of boiling water, and in 1.2 parts of boiling alcohol.

IMPURITIES.—Ammonium iodide and bromate, iron, barium, heavy metals.

INCOMPATIBLES.—Spirit of nitrous ether, as well as the incompatibles mentioned under the other bromides.

Dose, 1 gm. (15 gr.).

2. **CALCII BROMIDUM.**—Calcium Bromide. Abv.—Calc. Brom. $CaBr_2 = 199.91$.

It should contain not less than 84 per cent. of Calcium Bromide.

SOURCE.—From pure Calcium Carbonate by solution in Hydrobromic Acid, and evaporation. $CaCO_3 + 2HBr - CaBr_2 + CO_2 = H_2O$.

CHARACTERS.—A white, granular salt; odorless, and having a sharp, saline taste very deliquescent. *Solubility.*—Very soluble in water, and in Alcohol.

IMPURITIES.—Iodides, calcium bromate, insoluble matters, barium, heavy metals, nitrates, ammonia.

INCOMPATIBLES.—Acids, acid and metallic salts, alkaloids, chlorine water. The same incompatibles apply to the other bromides.

Dose, 1 gm. (15 gr.).

3. **LITHII BROMIDUM.**—Lithium Bromide. Abv.—Lith. Brom. $LiBr = 86.86$.

It should contain not less than 85 per cent. of Lithium Bromide.

SOURCE.—From a solution of Ferrous Bromide heated with Lithium Carbonate; when cool the solution is evaporated, and the salt obtained by crystallization $FeBr_2 + Li_2CO_3 = 2LiBr + FeCO_3$.

CHARACTERS.—A white, granular salt, odorless, and having a sharp, slightly bitter taste; very deliquescent. *Solubility.*—In 0.6 part of water, and in 0.14 part of boiling water; freely soluble in Alcohol and also soluble in Ether.

IMPURITIES.—Iodine, potassium, other alkalies, iron, aluminum, heavy metals.

Dose, 1 gm. (15 gr.).

4. **POTASSII BROMIDUM.**—Potassium Bromide. Abv.—Pot. Brom. $KBr = 119.02$.

It should contain not less than 98.5 per cent. of Potassium Bromide.

SOURCE.—By warming a solution of Potassium Hydroxide with Bromine, a

solution of the Bromide and Bromate is made. $3Br_2+6KOH=5KBr+KBrO_3+3H_2O$. On evaporation to dryness, mixing the salts with Charcoal and heating to redness, the Bromate is reduced to a Bromide, while the Oxygen unites with the Carbon, forming Carbonic Oxide, which escapes. $2KBrO_3+3C_2=2KBr+6CO$. By dissolving in water, the solution yields the Bromide in crystals.

CHARACTERS.—Colorless or white, cubical crystals, or as a granular powder; odorless, and having a strongly saline taste. It is permanent in the air. *Solubility.*—In about 1.5 parts of water and in about 250 parts of Alcohol; in 1 part of boiling water, and in 21 parts of boiling Alcohol; also soluble in Glycerin.

IMPURITIES.—Potassium bromate, iodides, heavy metals, barium, free alkali

Dose, 1 gm. (15 gr.).

5. SODII BROMIDUM.—Sodium Bromide. Abv.—Sod. Brom. NaBr = 102.92.

It should contain, when dried, not less than 98.5 per cent. of Sodium Bromide.

SOURCE.—Made from a solution of Sodium Hydroxide, as Potassium Bromide is made from a solution of Potassium Hydroxide.

CHARACTERS.—Colorless or white cubical crystals or as a white granular powder; odorless, and having a saline taste. *Solubility.*—In about 1 part of water; in 16 parts of Alcohol.

IMPURITIES.—Sodium bromate and iodide, heavy metals, barium, free alkali.

Dose, 1 gm. (15 gr.).

6. STRONTII BROMIDUM.—Strontium Bromide. Abv.—Stront. Brom. $SrBr_2+6H_2O=355.57$. It would contain not less than 98 per cent. of Strontium Bromide.

SOURCE.—By neutralizing dilute Hydrobromic Acid with Strontium Carbonate, filtration and evaporation. $SrCO_3+2HBr=SrBr_2+CO_2+H_2O$.

CHARACTERS.—Colorless, transparent, hexagonal crystals; odorless, and having a bitter, saline taste. Deliquescent in moist but efflorescent in very dry air. *Solubility.*—In 0.35 part of water, and in about 0.4 part of boiling water; soluble in alcohol; insoluble in ether.

IMPURITIES.—Barium, strontium iodide, heavy metals.

Dose, 1 gm. (15 gr.).

7. ACIDUM HYDROBROMICUM DILUTUM.—Diluted Hydrobromic Acid. Abv.—Acid Hydrobrom. Dil. An aqueous solution containing not less than 9.5 per cent, nor more than 10.5 per cent., by weight, of Hydrobromic Acid (HBr = 80.93).

SOURCE.—Potassium Bromide, in solution, is mixed with Sulphuric Acid, and Potassium Sulphate allowed to crystallize, the precipitate is washed upon the filter, and the filtrate is distilled nearly to dryness and then diluted to the proper strength. $2KBr+H_2SO_4=2HBr+K_2SO_4$.

CHARACTERS.—A colorless, odorless liquid, having a strongly acid taste; it is strongly acid to litmus.

IMPURITIES.—Sulphuric and hydrochloric acids, chlorides, iodine, arsenic, barium, heavy metals.

Dose 1 mil (15 ℳ).

For the Therapeutics of the Bromides *see* p. 707.

III. IODUM

IODUM.—Iodine. I = 126.92. It should contain not less than 99.5 per cent. of Iodine.

SOURCE.—Obtained from the ashes of sea-weed and from the mother-liquors of Chilian Sodium Nitrate.

CHARACTERS.—Heavy, bluish-black, brittle rhombic plates, having a metallic lustre, a distinctive odor, and a sharp and acrid taste. Sp. gr., 4.66 at 17°C. (62.6°F.). *Solubility.*—In about 2950 parts of water, in 12.5 parts of alcohol; in 80 parts of glycerin, and in 4 parts of carbon disulphide, freely in ether, chloroform, or aqueous solutions of iodides. Its solution in alcohol or in an aqueous solution of potassium iodide has a reddish-brown color, and its solution in chloroform or carbon disulphide, a violet color.

IMPURITIES.—Iodine cyanide, chlorine, bromine.

INCOMPATIBLES.—Metallic salts, mineral acids, alkaloids, oil of turpentine, ammonia; with the last two explosive compounds may be formed.

Dose, 0.005 gm. = 5 milligm. (1/12 gr.).

Preparations

1. **Liquor Iodi Compositus.**—Compound Solution of Iodine. Abv.—Liq. Iodi Co. *Synonym.*—Lugol's Solution. Iodine, 5; Potassium Iodide, 10; water to 100. *Strength.*—Not less than 4.8 per cent. nor more than 5.2 per cent. of Iodine and not less than 9.8 per cent. nor more than 10.2 per cent. of Potassium Iodide.

   Dose, 0.2 mil (3 ♏).

2. **Tinctura Iodi.**—Tincture of Iodine. Abv.—Tr. Iodi. Iodine 70; Potassium Iodide, 50; Distilled water, 50; Alcohol to 1000. *Strength.*—Not less than 6.5 per cent. nor more than 7.5 per cent. of Iodine and not less than 4.5 per cent. nor more than 5.5 per cent. of Potassium iodide.

   Dose, 0.1 mil (1½ ♏).

3. **Unguentum Iodi.**—Iodine Ointment. Abv.—Ung. Iodi. Iodine, 4; Potassium Iodide, 4; Glycerin, 12; Benzoinated Lard, 80. *Strength.*—4 per cent.

1. **AMMONII IODIDUM.**—Ammonium Iodide. Abv.—Ammon. Iod. $N\dot{H}_4I = 144.96$.

It should contain not less than 99 per cent. of Ammonium Iodide.

SOURCE.—Dissolve Potassium Iodide and Ammonium Sulphate in boiling water, add Alcohol, filter, wash, and evaporate the filtrate to dryness. $2KI + (NH_4)_2SO_4 = 2NH_4I + K_2SO_4$.

CHARACTERS.—Minute, colorless, cubical crystals, or a white, granular powder, odorless, and having a sharp, saline taste. It is very hygroscopic, and soon becomes yellow or yellowish-brown on exposure to the air and light, owing to the loss of ammonia and liberation of iodine. *Solubility.*—In 0.6 part of water, and in 3.7 parts of alcohol; and in 1.5 parts of glycerin, also in 0.5 part of boiling water.

IMPURITIES.—Barium, iron, free iodine, chlorides, bromides, heavy metals.

INCOMPATIBLES.—Bismuth subnitrate, spirit of nitrous ether, mineral acids and acid salts, silver nitrate, soluble lead salts, potassium chlorate, alkaloids, licorice and preparations containing starch. The same incompatibles apply to the other iodides.

Dose, 0.30 gm. = 300 milligm. (5 gr.).

2. POTASSII IODIDUM.—Potassium Iodide. Abv.—Pot. Iod. KI = 166.02. It should contain not less than 99 per cent. of Potassium Iodide.

SOURCE.—Dissolve Iodine in a hot solution of Potassium Hydroxide in distilled water. $3I_2+6KHO=5KI+KIO_3+3H_2O$. Evaporate and heat the residue with Charcoal; the Oxygen of the Iodate is carried off as Carbonic Oxide. $KIO_3+3C=KI+3CO$. Dissolve in boiling water, filter, wash and crystallize.

CHARACTERS.—Transparent and colorless, or more or less opaque and white, cubical crystals, or as a white, granular powder, having a pungent, saline, afterwards bitter taste. Permanent in dry, but slightly deliquescent in moist air. *Solubility.*—In 0.7 part of water; in 22 parts alcohol; in 2 parts of glycerin; also in 0.5 part of boiling water and 8 parts of boiling alcohol; in 2 of glycerin.

IMPURITIES.—Nitrates, nitrites, chlorides, bromides, potassium iodate, cyanide and thiosulphate, barium, free alkali.

Dose, 0.30 gm. = 300 milligm. (5 gr.).

Potassium Iodide is contained in **Liquor Iodi Compositus, Tinctura Iodi and Unguentum Iodi.**

Preparations

1. Acidum Hydriodicum Dilutum.—Diluted Hydriodic Acid. Abv.—Acid Hydriod. Dil. An aqueous solution containing not less than 9.5 per cent., nor more than 10.5 per cent. of Hydriodic Acid. It should not be dispensed if it contains free iodine.

SOURCE.—Potassium Iodide, 135; Potassium Hypophosphite, 10; Tartaric Acid, 136.5; Distilled Water, Diluted Alcohol, each a sufficient quantity, to make 1000. By solution and evaporation.

CHARACTERS.—A clear, colorless or not more than a pale yellow, odorless liquid, and having a strongly acid taste. Sp. gr., about 1.10. Miscible, in all proportions, with water or Alcohol.

IMPURITIES.—Arsenic, barium, heavy metals, sulphuric acid.

Dose, 0.5 mil (8 ♏).

2. Syrupus Acidi Hydriodici.—Syrup of Hydriodic Acid. Abv.—Syr. Acid. Hydriod. A syrupy liquid containing not less than 1.3 per cent., nor more than 1.45 per cent. of Hydriodic Acid.

SOURCE.—Diluted Hydriodic Acid, 125; Water, 300; Syrup, 575.

CHARACTERS.—A transparent, colorless, or not more than a pale straw-colored syrupy liquid, odorless, and having a sweet and acidulous taste. Sp. gr., about 1.215.

IMPURITY.—Free iodine.

Dose, 4 mils (1 fl. dr.).

3. SODII IODIDUM.—Sodium Iodide. Abv.—Sod. Iod. NaI = 149.92.

It contains not less than 99 per cent. of Sodium Iodide, nor more than 7 per cent. of moisture.

SOURCE.—Made from a solution of Sodium Hydroxide, as Potassium Iodide is made from a solution of Potassium Hydroxide. $3I_2 + 6NaHO = 5NaI + NaIO_3 + 3H_2O$.

CHARACTERS.—Colorless, cubical crystals, or as a white crystalline powder; odorless, and having a saline taste. *Solubility.*—In 0.55 part of water; in about 2 parts of alcohol, in 1 part of glycerin; in 0.4 part of boiling water.

IMPURITIES.—Potassium, heavy metals, sodium iodate, thiosulphate and cyanide, nitrates, nitrites, chlorides, bromides, free iodine, free alkali.

Dose, 0.30 gm. = 300 milligm. (5 gr.).

4. **STRONTII IODIDUM.**—Strontium Iodide. Abv.—Stront. Iod. $SrI_2 + 6H_2O = 449.57$.

It contains not less than 99 per cent. of Strontium Iodide.

SOURCE.—By neutralization of freshly prepared solution of Hydriodic Acid with Strontium Carbonate; the filtrate is concentrated and the salt obtained by crystallization. $2HI + SrCO_3 = SrI_2 + CO_2 + H_2O$.

CHARACTERS.—Colorless, transparent, hexagonal plates, or as a white granular powder, or in crystalline crusts; odorless, and having a bitter, saline, taste. It is deliquescent and is colored yellow by exposure to air and light. *Solubility.*—In about 0.2 part of water, soluble in alcohol; slightly soluble in ether.

IMPURITIES.—Barium, heavy metals.

Dose, 0.30 gm. = 300 milligm. (5 gr.).

For the Therapeutics of Iodine and the Iodides *see* p. 815.

GROUP II

Oxygen, Nitrogen Monoxide, Water, Hydrogen Dioxide

I. **OXYGENIUM.**—Oxygen. It contains not less than 95 per cent. by volume of O = 16.

SOURCE.—By heating Manganese Dioxide or Potassium Chlorate. $3MnO_2 = Mn_3O_4 + O_2$ or $2KClO_3 = KClO_4 + KCl$ and $KClO_4 = KCl + 2O_2$.

CHARACTERS.—A colorless, odorless and tasteless gas. It supports combustion more readily than air. *Solubility.*—One volume of oxygen dissolves in about 34 volumes of water and in about 3.6 volumes of alcohol at 25°C. (77°F.).

IMPURITIES.—Carbon dioxide, halogens, acids or bases.

For the Therapeutics of Oxygen *see* p. 448.

II. **NITROGENII MONOXIDUM.**—Nitrogen Monoxide. Abv.—Nitrogen Monox. *Synonyms.*—Nitrous Oxide. Nitrogen Monoxide gas. $N_2O = 44.02$.

SOURCE.—By slowly heating Ammonium Nitrate at a temperature not to exceed 250°C. (482°F.) and passing the gas through lime water and solution of ferrous sulphate to remove impurities. $NH_4NO_3 = N_2O + 2H_2O$.

CHARACTERS.—It is a colorless gas possessing a slight characteristic odor and a somewhat sweet taste. *Solubility.*—Quite soluble in water at low temperatures; 1 volume of water dissolves 1.3 volumes of Nitrous Oxide at 25°C. (77°F.).

IMPURITIES.—Carbon dioxide, halogens, acids, bases, reducing substances. For the Therapeutics of Nitrogen Monoxide *see* p. 788.

III. AQUA.—Water. $H_2O = 18.016$.—Potable water in its purest attainable state.

CHARACTERS.—A colorless, limpid liquid, practically tasteless and odorless. When heated nearly to the boiling point and agitated, no disagreeable odor is evolved.

IMPURITIES.—Soluble salts, lead, copper, iron, sulphates, chlorides, nitrates, nitrites, ammonium compounds and organic or other oxidizable substances.

IV. AQUA DESTILLATA.—Distilled water. Abv.—Aq. Dest.

SOURCE.—Take 1000 volumes of water, distil from a suitable apparatus provided with a block tin or glass condenser, reject the first 100 volumes, which contain volatile impurities, and preserve the next 750 in glass-stoppered bottles, rinsed with hot distilled water immediately before being filled.

CHARACTERS.—A colorless, limpid liquid, without odor or taste, and neutral to the official indicators.

TESTS.—When 100 mils are evaporated on a water bath to dryness, not more than 0.001 of *residue* should remain. On heating to boiling 100 mils acidulated with 10 mils of diluted sulphuric acid, and adding 0.1 mil of tenth-normal potassium permanganate volumetric solution, the color of the liquid should not be completely destroyed by boiling for ten minutes, nor by afterwards setting the vessel aside, well covered, for ten minutes (absence of *organic* or *other oxidizable substances*). Not the slightest turbidity should result upon the addition to separate portions, of barium chloride test solution (*sulphate*), silver nitrate t.s. (*chloride*), ammonium oxalate t.s. (*calcium*) hydrogen sulphide, t.s., or sodium sulphide, t.s. (*metals*); nor should its transparency be affected when it is mixed with twice its volume of calcium hydroxide t.s. (absence of *carbon dioxide*). It shows no deep yellow, orange or brown coloration when 1 mil of Nessler's reagent is added to 100 mils of the water (*ammonia*).

V. AQUA DESTILLATA STERILISATA.—Sterilized Distilled Water. Abv.—Aq. Dest. Steril.

SOURCE.—Transfer the necessary quantity of freshly distilled water to a flask of hard glass of sufficient size which has been previously cleansed and sterilized. Close the mouth of the flask with pledget of sterilized purified cotton, boil for thirty minutes and allow the water to cool without removing the plug. Finally protect the mouth of the flask and the cotton pledget by wrapping the top of the flask tightly with paper.

Sterilized distilled water should be used within forty-eight hours after its preparation.

Distilled Water or the Sterilized Distilled Water should always be used for making up prescriptions.

For the Therapeutics of Water *see* p. 564.

VI. LIQUOR HYDROGENII DIOXIDI.—Solution of Hydorgen Dioxide. Abv.—Liq. Hydrog. Diox. An aqueous solution of Hydrogen Dioxide (H_2O_2 =34.02), which should contain, when freshly prepared, about 3 per cent., by weight of Hydrogen Dioxide, corresponding to about 10 volumes of available Oxygen. Upon removing the stopper from the bottle, not more than a slight pressure should be observed.

SOURCE.—A solution of Barium Dioxide, 300, in cold distilled water, 500, refrigerated to below 10°C. (50°F.), is thoroughly mixed with the greater part of a cool solution of Phosphoric Acid, 96, in distilled water, 320; a certain portion of the latter solution being reserved to add from time to time to the liquid to render it acid whenever its reaction has become alkaline. $BaO_2+2H_3PO_4=Ba(H_2PO_4)_2+H_2O_2$. Filter, and wash with distilled water. Add Diluted Sulphuric Acid to the filtrate, and starch, 10; by agitation. Filter and re-filter until a clear solution is obtained.

CHARACTERS.—A colorless liquid, odorless or having an odor suggesting ozone, slightly acid to the taste, and producing a peculiar sensation and froth in the mouth; prone to deteriorate upon keeping, or upon protracted agitation, and rapidly decomposed by many oxidizing as well as reducing substances. If the stopper in the bottle is coated with paraffin or replaced by a pledget of purified cotton, deterioration is retarded.

IMPURITIES.—Free acids, arsenic, heavy metals, barium, hydrofluoric acid.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Hydrogen Dioxide *see* p. 325.

GROUP III

Sulphur

S=32.07

1. SULPHUR SUBLIMATUM.—Sublimed Sulphur. Abv.—Sulphur. Sublim. *Synonym.*—Flowers of Sulphur. It should contain not less than 99.5 per cent. of Sulphur.

SOURCE.—From Crude Sulphur by sublimation.

CHARACTERS.—A fine, yellow powder, having a slight, characteristic odor and a faintly acid taste. *Solubility.*—Practically insoluble in water; soluble or partially soluble in carbon disulphide, nearly insoluble in alcohol, chloroform or olive oil; nearly soluble in Ether.

Dose, 4 gm. (60 gr.).

Preparation

Unguentum Sulphuris.—Sulphur Ointment. Sublimed Sulphur, 150; Benzoinated Lard, 850.

2. SULPHUR PRÆCIPITATUM.—Precipitated Sulphur. Abv.—Sulphur Præc. *Synonym.*—Milk of Sulphur. It should contain, when dried, not less than 99.5 per cent. of Sulphur.

SOURCE.—Boil Sublimed Sulphur, 100; with Calcium Oxide, 50; in water. $6S+3CaO=2CaS_2+CaS_2O_3$. This gives a solution containing Calcium Sulphide and Calcium Thiosulphate. To it Hydrochloric Acid is added, and Sulphur is thrown down as a very fine precipitate. $2CaS_2+CaS_2O_3+6HCl=3CaCl_2+6S+3H_2O$. Wash and dry the precipitate.

CHARACTERS.—A fine, amorphous powder of a pale yellow color, without odor or taste.

IMPURITIES.—Arsenic, acids, alkalies.

Dose, 4 gm. (60 gr.).

3. SULPHUR LOTUM.—Washed Sulphur. Abv.—Sulphur. Lot. It should contain, when dried, not less than 99.5 per cent. of Sulphur.

SOURCE.—Sublimed Sulphur, 100; with water, 100; and Ammonia Water, 10; is digested for three days, when water, 100, is added, the mixture strained, and the Sulphur washed with water. It is then drained, and the residue strongly pressed, dried, and passed through a sieve.

CHARACTERS.—A fine, yellow powder, without odor or taste.

IMPURITIES.—Acids, alkalies, arsenic, ammonia, earthy and metallic impurities.

Dose, 4 gm. (60 gr.).

Washed Sulphur is contained in Pulvis Glycyrrhizæ Compositus.

For the Therapeutics of Sulphur *see* p. 327.

4. CALCII SULPHIDUM CRUDUM.—Crude Calcium Sulphide. *Synonym.*—Sulphurated Lime. A mixture containing not less than 55 per cent. of Calcium Sulphide ($CaS=72.14$).

SOURCE.—Obtained by heating a mixture of Exsiccated Calcium Sulphate, 70; Charcoal, 10; and Starch, 2.

CHARACTERS.—A pale gray or yellowish powder, having a faint odor of hydrogen sulphide, and a nauseous, and alkaline taste, and gradually decomposed by exposure to moist air. *Solubility.*—Very slightly in cold water; more readily in boiling water, which partially decomposes it; readily dissolved by solutions of ammonium salts; insoluble in Alcohol.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

5. POTASSA SULPHURATA.—Sulphurated Potassa. Abv.—Pot. Sulphurat. *Synonym.*—Liver of Sulphur. A mixture composed chiefly of Potassium Polysulphides and Potassium Thiosulphate and containing an amount of sulphides corresponding to not less than 12.8 per cent. of Sulphur.

SOURCE.—By fusing Sublimed Sulphur and Potassium Carbonate.

CHARACTERS.—In irregular pieces, liver-brown when freshly made, changing to greenish-yellow and finally to gray through absorption of moisture, oxygen and carbon dioxide from the air. It has a strong odor of Hydrogen Sulphide and a bitter, acrid, and alkaline taste. *Solubility.*—Very soluble in water, usually leaving a slight residue. Alcohol dissolves only the sulphides.

For the Therapeutics of Crude Calcium Sulphide and Sulphurated Potassa *see* p. 331.

GROUP IV

Phosphorus, Arsenic, Antimony

I. PHOSPHORUS (Abv.—Phosphor.)

P = 31.04

Phosphorus must be carefully preserved under water, in strong, well-closed containers, in a secure and moderately cool place, protected from light.

SOURCE.—Treat Calcium Phosphate with Sulphuric Acid, filter and evaporate. $Ca_3(PO_4)_2+2H_2SO_4=CaH_4(PO_4)_2+2CaSO_4$. Heat the Acid Calcium Phosphate thus formed with Charcoal, which first forms Calcium Metaphosphate $CaH_4(PO_4)_2=Ca(PO_3)_2+2H_2O$. This is acted on by the Charcoal thus: $2Ca(PO_3)_2+5C=2CaO+5CO_2+2P_2$.

CHARACTERS.—A translucent, nearly colorless solid, of a waxy lustre, having, at ordinary temperatures, about the consistence of beeswax. By long keeping the surface becomes white or red, and occasionally black. It has a distinctive and disagreeable odor and taste *but should not be tasted, except in a very dilute solution.* When exposed to the air it emits white fumes, which are luminous in the dark, and have an odor somewhat resembling garlic; on longer exposure to air, it often takes fire spontaneously. Heated with Hydrogen, it becomes red, amorphous, non-poisonous Phosphorus. Sp. gr., 1.830 at 10°C. (50°F.). *Solubility.*—In 0.9 part of Carbon Disulphide; in about 17 parts of Chloroform, 102 parts of Absolute Ether, 31.5 parts of Benzene, and 400 parts of Dehydrated Alcohol; sparingly in fixed oils; almost insoluble in water, to which it imparts its characteristic odor and taste.

IMPURITIES.—Arsenic, sulphur.

INCOMPATIBLES.—All oxidizers, as potassium chlorate and permanganate, chlorine, hydrochloric acid, etc.

Dose, 0.0005 gm. = 0.5 milligm. (1/120 gr.).

Preparation

Pilulæ Phosphori.—Pills of Phosphorus. Abv.—Pil. Phosphor. Add Phosphorus, .06, dissolved in Chloroform, 5, to a mixture of Althea, 6, and Acacia, 3; then add a sufficient quantity of a mixture of Glycerin, 2 volumes, and water, 1 volume, to make 100 pills. Finally the pills are coated with a solution of Balsam of Tolu, 10 gm., in Ether, 15 mils. *Strength.*—Each pill contains 0.0006 gm. (1/100 gr.) of Phosphorus.

Dose, 1 pill.

For the Therapeutics of Phosphorus *see* p. 791.

1. CALCII HYPOPHOSPHIS.—Calcium Hypophosphite. Abv.—Calc. Hypophos. $Ca(PH_2O_2)_2=170.18$. It should contain not less than 98 per cent. of Calcium Hypophosphite. Caution should be observed in dispensing this and other hypophosphites, as an explosion is liable to occur when they are triturated or heated with nitrates, chlorates, or other oxidizing agents.

SOURCE.—Heat Phosphorus with Milk of Lime. Then pass Carbon Dioxide through the liquid to remove the excess of Lime. The Hypophosphite crystallizes out of the solution. $3Ca(OH)_2+4P_2+6H_2O=3Ca(PH_2O_2)_2+2PH_3$.

CHARACTERS.—Colorless, transparent, monoclinic prisms, or small, lustrous scales, or a white, crystalline powder, odorless and having a nauseous, bitter taste; permanent in the air. *Solubility.*—In 6.5 parts of water; insoluble in Alcohol.

IMPURITIES.—Calcium phosphate and sulphate, arsenic, heavy metals.

INCOMPATIBLES.—Arsenic salts, bromine and bromates, chlorine and chlorates, chromates, copper salts, ferric salts, iodine and iodates, nitric acid, permanganates, phosphates, sulphuric and sulphurous acids. The same incompatibles apply to the other Hypophosphites and to Hypophosphorous acid.

It is used to prepare Syrupus Hypophosphitum.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

2. POTASSII HYPOPHOSPHIS.—Potassium Hypophosphite. Abv.—Pot. Hypophos. $KPH_2O_2=104.16$. It should contain not less than 98 per cent. of Potassium Hypophosphite.

SOURCE.—From double decomposition of Calcium Hypophosphite and Potassium Carbonate; the Potassium Hypophosphite remains in solution. $Ca(PH_2O_2)_2+K_2CO_3=CaCO_3+2KPH_2O_2$.

CHARACTERS.—White, opaque, hexagonal plates, or crystalline masses, or a granular powder; odorless, and having a pungent, saline taste. Very deliquescent. *Solubility.*—In 0.6 part of water and 9 parts of Alcohol; in 0.4 part of boiling water and 5 parts of boiling Alcohol; insoluble in Ether.

It is used to prepare Syrupus Hypophosphitum.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

3. SODII HYPOPHOSPHIS.—Sodium Hypophosphite. Abv.—Sod. Hypophos. $NaPH_2O_2+H_2O=106.07$. It should contain not less than 98 per cent. of Sodium Hypophosphite.

SOURCE.—Add Sodium Carbonate to a solution of Calcium Hypophosphite, and evaporate the filtrate. $Ca(PH_2O_2)_2+Na_2CO_3=CaCO_3+2NaPH_2O_2$.

CHARACTERS.—Small colorless, transparent, rectangular plates of a pearly lustre, or a white granular powder; odorless, and having a saline taste. It is deliquescent on exposure to moist air. *Solubility.*—In about 1 part of water and 25 parts of Alcohol; in 0.12 part of boiling water and 1 part of boiling Alcohol.

IMPURITIES.—Calcium, sodium carbonate, caustic alkali, arsenic, heavy metals.

It is used to prepare Syrupus Hypophosphitum.

Dose, 1 gm. (15 gr.).

4. ACIDUM HYPOPHOSPHOROSUM.—Hypophosphorous Acid. Abv.—Acid. Hypophos. A liquid containing not less than 30 per cent. nor more than 32 per cent. of Hypophosphorous Acid.

SOURCE.—Heat Phosphorus with solution of Potassium or Sodium Hydroxide; the hypophosphite thus obtained is decomposed with Sulphuric or Tartaric Acid; filter the concentrated solution, and concentrate under the air-pump (heat decomposes it) until the desired strength is reached.

CHARACTERS.—A colorless or slightly yellow, odorless, liquid; it has an intensely acid taste. Sp. gr., about 1.130.

IMPURITIES.—Potassium, barium, arsenic and phosphoric, sulphuric, oxalic and tartaric acids.

5. ACIDUM HYPOPHOSPHOROSUM DILUTUM.—Diluted Hypophosphorous acid. Abv.—Acid Hypophos. Dil. An aqueous solution containing not less than 9.5 per cent. of Hypophosphorous Acid.

SOURCE.—Hypophosphorous Acid, 100; Distilled Water, 210.

CHARACTERS.—A colorless liquid, without odor, and having a strongly acid taste. Sp. gr., about 1.042. *Solubility.*—Miscible, in all proportions, with water.

Dose, 0.5 mil (8 ♏).

Diluted Hypophosphorous Acid is used to prepare Syrupus Ferri Iodidi.

Preparation

Syrupus Hypophosphitum.—Syrup of Hypophosphites. Abv.—Syr. Hypophos. Calcium Hypophosphite, 45; Potassium Hypophosphite, 15; Sodium Hypophosphite, 15; Diluted Hypophosphorous Acid, 2; Glycerin, 50; sugar, 600; and sufficient distilled water to make 1000.

Dose, 10 mils (2½ fl. dr.).

6. CALCII GLYCEROPHOSPHAS.—Calcium Glycerophosphate. Abv.—Calc. Glycerophos. *Synonym.*—Calcium Glycerinophosphate. The normal Calcium salt of Glycerophosphoric Acid ($C_3H_5(OH)_2PO_4H_2 = 172.11$) containing when dried to constant weight not less than 98 per cent. of $CaC_3H_7PO_6$ or $C_3H_5(OH)_2PO_4Ca = 210.17$.

SOURCE.—Phosphoric Acid is treated with Glycerin for several days, its acidity neutralized with Calcium Carbonate and the salt precipitated with Alcohol.

CHARACTERS.—A fine white powder; odorless and almost tasteless; somewhat hygroscopic. *Solubility.*—In about 50 parts of water at 25°C. (77°F.); soluble in less water at a lower temperature; citric acid increases its solubility; insoluble in Alcohol.

IMPURITIES.—Phosphates, chlorides, sulphates, alcohol-soluble impurities.

Dose, 0.250 = 250 milligm. (4 gr.).

7. SODIUM GLYCEROPHOSPHAS.—Sodium Glycerophosphate. Abv.—Sod. Glycerophos. *Synonym.*—Sodium Glycerinophosphate. Hydrated Sodium Glycerophosphate contains not less than 68 per cent. of the anhydrous salt ($Na_2C_3H_7PO_6$ or $C_3H_5(OH)_2PO_4Na_2 = 216.10$.

SOURCE.—By the same method as for Calcium Glycerophosphate, Sodium Carbonate being substituted for the Calcium Carbonate.

CHARACTERS.—White, monoclinic plates or scales or as a white powder, having a saline taste; odorless. *Solubility.*—Very soluble in hot or cold water; nearly insoluble in Alcohol.

IMPURITIES.—Free alkali, phosphates, alcohol-soluble impurities.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Liquor Sodii Glycerophosphatis.—Solution of Sodium Glycerophosphate. Abv.—Liq. Sod. Glycerophos. *Synonym.*—Solution of Sodium Glycerinophosphate. An aqueous solution of Sodium Glycerophosphate containing not less than 50 per cent. of the anhydrous salt, $Na_2C_3H_7PO_6$ or $C_3H_5(OH)_2PO_4Na_2 = 216.10$.

CHARACTERS.—A clear, colorless or yellowish, syrupy liquid.

IMPURITIES.—The same as of Sodium Glycerophosphate.

Dose, 0.35 mil (6 ♏).

For the Therapeutics of the Hypophosphites and Glycerophosphates *see* p. 793.

II. ARSENUM

$As = 74.96$

Arsenic is a perfect analogue of Phosphorus. In its free state it is similar to the metals.

1. **ARSENI TRIOXIDUM.**—Arsenic Trioxide. Abv.—Arsen. Triox. $As_2O_3 = 197.92$. *Synonyms.*—Arsenous Acid. White Arsenic. It should contain not less than 99.8 per cent. of Arsenic Trioxide.

SOURCE.—Arsenical ores are roasted and purified by sublimation.

CHARACTERS.—It occurs either as an opaque, white powder, or in irregular masses of two varieties: one amorphous, transparent and colorless, like glass; the other crystalline, opaque and white, resembling porcelain. *Caution should be used in tasting this and other arsenical compounds, as they are very poisonous. Solubility.*—In water, the amorphous or glassy variety being somewhat more soluble than the crystalline variety; freely in glycerin; slightly soluble in alcohol and ether. It is dissolved by hydrochloric acid and alkaline solutions.

IMPURITIES.—Arsenic acid, arsenous sulphide, tin, antimony, cadmium.

INCOMPATIBLES.—Hypophosphorous acid, copper, iron and silver salts, lime water, magnesia, potassium iodide, vegetable astringents. The same incompatibles apply to the Arsenites.

Dose, 0.002 gm. = 2 milligm. (1/30 gr.).

Preparations

1. **Liquor Acidi Arsenosi.**—Solution of Arsenous Acid. Abv.—Liq. Acid. Arsen. Arsenic Trioxide, 10, is boiled with Diluted Hydrochloric Acid, 50, and distilled water, 250, until complete solution, and distilled water is added to make 1000. No decomposition occurs, but an acid solution of Arsenic Trioxide is formed. *Strength.*—1 per cent. of Arsenic Trioxide.

Dose, 0.2 mil (3 ♏).

2. **Liquor Potassii Arsenitis.**—Solution of Potassium Arsenite. Abv.—Liq. Pot. Arsen. *Synonym.*—Fowler's solution. Arsenic Trioxide,

10; Potassium Bicarbonate, 20; Compound Tincture of Lavender, 30. The Compound Tincture of Lavender is added after the Arsenic Trioxide and Potassium Bicarbonate have been dissolved by boiling with distilled water, 100, and sufficient distilled water has been added to make 970. The following equation expresses the chemical reaction which takes place: $As_2O_3+4KHCO_3=2K_2HAsO_3$. *Strength.*—1 per cent. of Arsenic Trioxide.

Dose, 0.2 mil (3 ♏).

2. **SODII ARSENAS.**—Sodium Arsenate. Abv.—Sod. Arsen. $Na_2HAsO_4+7H_2O=312.08$. It should contain not less than 58.98 per cent. nor more than 61.92 per cent. of anhydrous sodium arsenate (di-sodium ortho-arsenate) corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—Heat to redness Arsenic Trioxide, Sodium Nitrate, and Sodium Carbonate; dissolve the fused mass in water and crystallize. Sodium Pyroarsenate is formed. $As_2O_3+2NaNO_3+Na_2CO_3=Na_4As_2O_7+N_2O_3+CO_2$. On adding water to the Pyroarsenate, a solution of Sodium Arsenate, which crystallizes on standing, is formed. $Na_7As_2O_7+H_2O=2Na_2HAsO_4$, which crystallizes with $7H_2O$.

CHARACTERS.—Colorless, transparent, monoclinic prisms; odorless. *Great caution should be used in tasting it and then only in very dilute solutions. Solubility.*—In 1.5 parts of water; also in about 1 part of boiling water; slightly soluble in cold, and nearly insoluble in boiling, Alcohol.

IMPURITIES.—Sodium arsenite, lead, copper, iron, etc.

Dose, 0.005 gm. = 5 milligm. (1/12 gr.).

3. **SODII ARSENAS EXSICCATUS.**—Exsiccated Sodium Arsenate. Abv.—Sod. Arsen. Exsic. $Na_2HAsO_4=185.97$. It should contain not less than 98 per cent. of anhydrous di-sodium ortho-arsenate.

SOURCE.—Break crystals of Sodium Arsenate into small fragments, and allow them to effloresce at a temperature between 40° and 50°C. (104 and 122°F.) until they are completely disintegrated; gradually increase the temperature to 150°C. (302°F.), and continue the drying until the product ceases to lose weight; then reduce to a fine powder.

CHARACTERS.—An odorless, amorphous white powder. It is slightly hygroscopic. *Great caution should be used in tasting it and then only in very dilute solution.*

Dose, 0.003 gm. = 3 milligm. (1/20 gr.).

Preparation

Liquor Sodii Arsenatis.—Solution of Sodium Arsenate. Abv.—Liq. Sod. Arsen. *Synonym.*—Pearson's solution. (Pearson's solution is really only about one-tenth as strong as the official Liquor Sodii Arsenatis.)

SOURCE.—Dissolve Exsiccated Sodium Arsenate, 1, in sufficient distilled water to make 100. *Strength.*—1 per cent. of Exsiccated Sodium Arsenate.

Dose, 0.2 mil (3 ♏).

4. SODIUM CACODYLAS.—Sodium Cacodylate. Abv.—Sod. Cacodyl. Sodium dimethylarsenate ($Na(CH_3)_2AsO_2 = 160.01$), with a somewhat variable amount of water of crystallization. It contains not less than 72 per cent. nor more than 75 per cent. of Sodium Cacodylate.

SOURCE.—By neutralizing a solution of Cacodylic Acid, which is Arsenic Acid in which two hydroxyls (OH) are replaced by two molecules of the methyl group (CH_3), with Sodium Bicarbonate.

CHARACTERS.—White, odorless, deliquescent prisms, or as a granular powder. *Solubility.*—It dissolves in about 0.5 part of water; in about 2.5 parts of alcohol at 25°C. (77°F.).

IMPURITIES.—Monomethyl arsenate, arsenates, phosphates, chlorides, sulphates.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

5. ARSENI IODIDUM.—Arsenous Iodide. Abv.—Arsen. Iod. $AsI_3 = 455.72$.

It contains, when dried to a constant weight, not less than 99 per cent. Arsenous Iodide.

SOURCE.—Made by the direct union of Iodine and Metallic Arsenic, or by mixing solutions of Arsenous and Hydriodic Acids, and evaporating.

CHARACTERS.—An orange-red, inodorous, crystalline powder. *Solubility.*—In about 12 parts of water (with partial decomposition); soluble in alcohol, chloroform, ether, or carbon disulphide.

Dose, 0.005 gm. = 5 milligm. ($\frac{1}{12}$ gr.).

Preparation

Liquor Arseni et Hydrargyri Iodidi. *See* Mercury, p. 79.

For the Therapeutics of Arsenical Compounds *see* p. 415.

III. ANTIMONIUM

Sb = 120.2

Antimony is analogous to Phosphorus and Arsenic. In its physical properties it is a metal.

ANTIMONII ET POTASII TARTRAS.—Antimony and Potassium Tartrate. Abv.—Antim. et Pot. Tart. $K(SbO)C_4H_4O_6 + \frac{1}{2}H_2O = 332.34$. *Synonyms.*—Tartar Emetic. Antimonyl Potassium Tartrate. Tartrated Antimony. It contains not less than 98.5 per cent. of Antimony and Potassium Tartrate.

SOURCE.—Make a paste of Antimony Trioxide (Sb_2O_3) with Acid Potassium Tartrate and water. Let it stand twenty-four hours, boil in water, and crystallize. $2KHC_4H_4O_6 + Sb_2O_3 = 2K(SbO)C_4H_4O_6 + H_2O$.

CHARACTERS.—Colorless, transparent crystals of the rhombic system, or a white, granular powder; without odor, and having a sweet, afterwards disagreeable, metallic taste. The crystals effloresce on exposure to the air. *Solubility.*—In 12 parts of water and in 15 parts of Glycerin; insoluble in Alcohol.

IMPURITIES.—Sulphate and chloride, potassium bitartrate, calcium, arsenic, iron, heavy metals.

INCOMPATIBLES.—Gallic and tannic acids, most astringent infusions, alkalies, lead salts.

It is used to prepare Mistura Glycyrrhizæ Composita.

Dose (expectorant), 0.005 gm. = 5 milligm. (1/12 gr.).

Preparation

Syrupus Scillæ Compositus.—Compound Syrup of Squill. Abv.—Syr. Scill. Co. *Synonym.*—Hive Syrup, so called from hives, the old name of croup. Fluidextract of Squill, 80; Fluidextract of Senega, 80; Antimony and Potassium Tartrate, 2; distilled water, 10; Syrup to 1000.

Dose, 2 mils (30 ♏).

For the Therapeutics of Antimony and Potassium Tartrate *see* p. 555.

GROUP V

Carbon, Silicon

I. CARBO

C = 12

1. **CARBO LIGNI.**—Charcoal. Abv.—Carbo. Lig. *Synonym.*—Wood Charcoal.

Charcoal prepared from soft wood, and very finely powdered.

SOURCE.—Wood charred without access of air.

CHARACTERS.—A black, odorless, and tasteless powder, free from gritty matter.

INCOMPATIBLES.—All oxidizers.

Dose, 1 gm. (15 gr.).

For Therapeutics of Charcoal *see* p. 331.

2. **PETROLATUM.**—Petrolatum. Abv.—Petrolat. *Synonyms.*—Petrolatum Ointment. Petrolatum Jelly. A purified mixture of semi-solid Hydrocarbons, chiefly of the methane series obtained from petroleum.

CHARACTERS.—An unctuous mass, varying in color from yellowish to light amber; having not more than a slight fluorescence, even after being melted; transparent in thin layers; completely amorphous; free or nearly free from odor or taste. Sp. gr., 0.820 to 0.850 when it is liquefied and brought to a temperature of 60°C. (140°F.). *Solubility.*—Insoluble in water; almost insoluble in cold or hot alcohol, or in cold dehydrated alcohol; but freely soluble in ether, chloroform, carbon disulphide, oil of turpentine, petroleum benzin, benzene, and in most fixed or volatile oils.

IMPURITIES.—Rosin, fixed oils and fats of animal or vegetable origin, readily carbonizable organic impurities.

3. **PETROLATUM ALBUM.**—White Petrolatum. Abv.—Petrolat. Alb. Petrolatum wholly or nearly decolorized.

SOURCE.—Obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue.

CHARACTERS.—A white or faintly yellowish unctuous mass, transparent in thin layers, even after cooling to 0° C. (32° F.); completely amorphous. In other respects it has the same characteristics of Petrolatum, and it is liable to contain the same impurities.

4. **PETROLATUM LIQUIDUM.**—Liquid Petrolatum. Abv.—Petrolat. Liq. *Synonyms.*—Liquid Paraffin. Mineral Oil. A mixture of liquid hydrocarbons, obtained from petroleum. It occurs as either a Heavy or Light Liquid Petrolatum, depending upon its viscosity.

SOURCE.—Obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue.

CHARACTERS.—A colorless, transparent liquid, free, or nearly free, from fluorescence, odorless and tasteless when cold; when heated, possessing not more than a faint petroleum odor. Sp. gr., about 0.828 to 0.905. *Solubility.*—Insoluble in water or alcohol; soluble in ether, chloroform, petroleum benzin, and in fixed or volatile oils. Camplor, menthol, thymol and many similar substances are dissolved by Liquid Petrolatum.

For the Therapeutics of Petrolatum *see* p. 532.

5. **BENZINUM PURIFICATUM.**—Purified Petroleum Benzin. Abv.—Benzin. Purif. *Synonym.*—Petroleum Ether.

SOURCE.—A purified distillate from American petroleum, consisting of hydrocarbons, chiefly of the marsh-gas series.

CHARACTERS.—A clear, colorless non-fluorescent volatile liquid, of an ethereal or faint petroleum-like odor, and having a neutral reaction. It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently. Sp. gr., 0.638 to 0.660. *Solubility.*—Practically insoluble in water; soluble in alcohol, and miscible with ether, chloroform, benzene, volatile oils, and fixed oils, with the exception of castor oil.

IMPURITY.—Benzene, pyrogenous products and sulphur compounds.

For the Uses of Purified Petroleum Benzin *see* p. 828.

6. **PARAFFINUM.**—Paraffin. Abv.—Paraff. A purified mixture of solid hydrocarbons.

SOURCE.—Usually obtained by chilling and pressing the distillates from petroleum having high boiling points, and purifying the solid press cake so obtained.

CHARACTERS.—A colorless, or white, more or less translucent mass, crystalline when separating from solution; without odor or taste, and slightly greasy to the touch. Sp. gr., about 0.900. *Solubility.*—Insoluble in water or alcohol; slightly soluble in dehydrated alcohol; freely soluble in ether, petroleum, benzin, carbon disulphide, volatile oils, and in most warm fixed oils.

IMPURITIES.—Various acids.

For the Uses of Paraffin *see* p. 828.

II. SILICON

Si = 28.3

TERRA SILICEA PURIFICATA.—Purified Siliceous Earth. Abv.—Ter. Sil. Purif. *Synonyms.*—Purified Kieselguhr. Purified Infusorial Earth. A form of silica (SiO_2 = 60.30) consisting of the frustules and fragments of diatoms, purified by boiling with diluted Hydrochloric Acid, washing and calcining.

CHARACTERS.—A very bulky and very fine powder, white or of a pale light gray or pale buff color; without odor or taste. It readily absorbs moisture, and will retain about four times its weight of water without the mixture becoming fluid. *Solubility.*—Insoluble in water, acids or dilute alkaline solutions.

IMPURITIES.—Carbonates, sulphates, iron.

For the Uses of Purified Siliceous Earth *see* p. 829.

Various compounds containing Carbon will be found in Section II, Division I, "The Synthetics and Allied Drugs."

GROUP VI

The Acids

Those acids which will be considered here may be divided into two classes.

Class I.—Those which are strongly acid, the more powerful being active caustics. They are **Sulphuric, Nitric, Hydrochloric, Nitrohydrochloric, Phosphoric, Acetic, Glacial Acetic, Tartaric, Citric** and **Lactic** acids. **Hydrobromic, Hydriodic** and **Hypophosphorous** acids have already been considered (*see* pp. 35, 37, and 43).

Class II.—That which, although feebly acid is powerfully antiseptic, **Boric** acid.

Diluted Hydrocyanic, Benzoic, Gallic, Tannic, Oleic, Phenylcinchoninic, Stearic, Trichloracetic and Salicylic acids and Phenol (Carbolic Acid) are not used as acids, and will be considered under other headings.

What were formerly termed Arsenous Acid and Chromic Acid are not true acids; they are Trioxides, and are considered elsewhere (*see* pp. 45 and 87).

CLASS I.—THE STRONG ACIDS

1. **ACIDUM SULPHURICUM.**—Sulphuric Acid. Abv.—Acid. Sulphuric. *Synonym.*—Oil of Vitriol. A liquid composed of not less than 93 per cent., nor more than 95 per cent. of Sulphuric Acid [H_2SO_4 or $SO_2(OH)_2$ = 98.09].

SOURCE.—Produced by the combustion of Sulphur or Iron Pyrites, and the oxidation and hydration of the resulting Sulphur Dioxide gas by means of nitrous and aqueous vapors.

CHARACTERS.—A colorless, odorless, liquid of oily consistence, very caustic and corrosive. Sp. gr., about 1.83. Miscible, in all proportions, with water

or alcohol, with the evolution of much heat; therefore, the acid must be cautiously added to the diluent.

IMPURITIES.—Nitric, nitrous, sulphurous and hydrochloric acids, lead, arsenic, heavy metals.

INCOMPATIBLES.—Alkalies and their carbonates, barium, calcium, lead and silver salts, hypophosphorous acid, vegetable astringent infusions.

Sulphuric Acid is used in Liquor Ferri Subsulphatis, Liquor Ferri Tersulphatis, and Spiritus Ætheris Nitrosi.

Preparations

1. **Acidum Sulphuricum Aromaticum.**—Aromatic Sulphuric Acid. Abv.—Acid. Sulph. Arom. *Synonym.*—Elixir of Vitriol. Sulphuric Acid, 109; Oil of Cinnamon, 1; Tincture of Ginger, 50; Alcohol, a sufficient quantity to make 1000. Sp. gr., about 0.933. It should contain not less than 19 per cent. nor more than 21 per cent., of Sulphuric Acid, in the form of Ethyl-Sulphuric Acid and free Sulphuric Acid.

Dose, 1 mil (15 ♏).

2. **Acidum Sulphuricum Dilutum.**—Diluted Sulphuric Acid. Abv.—Acid. Sulph. Dil. Sulphuric Acid, 50; distilled water, 420. Sp. gr., about 1.067. Contains not less than 9.5 per cent. nor more than 10.5 per cent. of Sulphuric Acid.

Dose, 1 mil (15 ♏).

Diluted Sulphuric Acid is used to prepare Ferri Sulphas Granulatus.

2. **ACIDUM NITRICUM.**—Nitric Acid. Abv.—Acid. Nitric. A liquid composed of not less than 67 per cent. nor more than 69 per cent. of Nitric Acid (HNO_3 or $NO_2 \cdot OH = 63.02$).

SOURCE.—Made from Potassium Nitrate by distilling with Sulphuric Acid. $KNO_3 + H_2SO_4 = KHSO_4 + HNO_3$.

CHARACTERS.—A fuming liquid, very caustic and corrosive, and having a peculiar, somewhat suffocating odor. Sp. gr., about 1.403.

IMPURITIES.—Sulphuric, hydrochloric, iodic and bromic acids, iodine, bromine, arsenic, heavy metals, nitre, and lower nitrogen oxides, giving ruddy fumes.

INCOMPATIBLES.—Alcohol, alkalies, carbonates, oxides, ferrous sulphate, lead acetate.

Nitric Acid is contained in Liquor Ferri Subsulphatis, Liquor Zinci Chloridi, and Unguentum Hydrargyri Nitratis.

Preparations

1. **Acidum Nitrohydrochloricum.**—Nitrohydrochloric Acid. Abv.—Acid. Nitrohydrochl. *Synonyms.*—Nitromuriatic Acid. Aqua regia. Nitric Acid, 18; Hydrochloric Acid, 82. A golden-yellow, fuming, and very corrosive liquid, having a strong odor of chlorine.

Dose, 0.2 mil (3 ♏).

2. **Acidum Nitrohydrochloricum Dilutum.**—Diluted Nitrohydrochloric Acid. Abv.—Acid. Nitrohydrochl. Dil. *Synonym.*—Diluted

Nitromuriatic Acid. Nitric Acid, 10; Hydrochloric Acid, 45.5; distilled water, 194.5. It contains free Chlorine, Hydrochloric, Nitric and Nitrous Acids, and other compounds dissolved in water. It is a colorless or pale yellow liquid, having a faint odor of chlorine and should not be dispensed unless recently prepared.

Dose, 1 mil (15 ♏).

3. **ACIDUM HYDROCHLORICUM.**—Hydrochloric Acid. Abv.—Acid. Hydrochl. A liquid compound of not less than 31 per cent., nor more than 33 per cent. of Hydrochloric Acid ($HCl = 36.47$).

SOURCE.—The fumes produced by the action of Sulphuric Acid on Sodium Chloride are dissolved in water. $2NaCl + H_2SO_4 = HCl + NaCl + NaHSO_4$ and $NaCl + NaHSO_4 = HCl + Na_2SO_4$.

CHARACTER.—A colorless, fuming liquid, having a pungent odor, and an intensely acid taste. Sp. gr., about 1.155. Miscible, in all proportions, with water or alcohol.

IMPURITIES.—Bromine, iodine, free chlorine, heavy metals, sulphates and sulphuric and sulphurous acids.

INCOMPATIBLES.—Lead and silver salts, alkalies and their carbonates, oxidizable substances (with which it forms explosive compounds), alcohols, ethers, carbohydrates, sulphur and sulphides, phosphorus, etc.

Hydrochloric Acid is contained in Liquor Ferri Chloridi and Liquor Zinci Chloridi *and is used to prepare* Resina Podophylli and Extractum Ergotæ.

Preparations

1. **Acidum Hydrochloricum Dilutum.**—Diluted Hydrochloric Acid. Abv.—Acid. Hydrochl. Dil. *Synonym.*—Diluted Muriatic Acid. Hydrochloric Acid, 100; distilled water, 220. It should contain not less than 9.5 per cent., nor more than 10.5 per cent. of Hydrochloric Acid. Sp. gr., about 1.049.

Dose, 1 mil (15 ♏).

Diluted Hydrochloric Acid is contained in Liquor Acidi Arsenosi.

2. **Acidum Nitrohydrochloricum.**—*See* Nitric Acid, p. 51.

3. **Acidum Nitrohydrochloricum Dilutum.**—*See* Nitric Acid, p. 51.

4. **ACIDUM PHOSPHORICUM.**—Phosphoric Acid. Abv.—Acid. Phos. A liquid composed of not less than 85 per cent., nor more than 88 per cent. of Phosphoric Acid [$H_3PO_4 = 98.06$].

SOURCE.—When Phosphorus is brought into contact with Nitric Acid, it is slowly oxidized and converted into Phosphoric Acid. $P_3 + 5HNO_3 + 2H_2O = 3H_3PO_4 + 5NO$.

CHARACTERS.—A colorless, odorless liquid of a syrupy consistence and having a strongly acid taste. Sp. gr., 1.74. Miscible, in all proportions, with water or alcohol.

IMPURITIES.—Metaphosphoric, pyrophosphoric, phosphorous, sulphuric, nitric, and hydrochloric acids, phosphates, arsenic heavy metals.

Phosphoric Acid is contained in Syrupus Calcii Lactophosphatis.

Preparation

Acidum Phosphoricum Dilutum.—Diluted Phosphoric Acid. Abv.—Acid. Phos. Dil. Phosphoric Acid, 100; distilled water, 675. Sp. gr., about 1.057. It should contain not less than 9.5 per cent., nor more than 10.5 per cent. of Phosphoric Acid.

Dose, 2 mils (30 ♏).

5. ACIDUM ACETICUM.—Acetic Acid. Abv.—Acid. Acet. A liquid composed of not less than 36 per cent. nor more than 37 per cent. of Acetic Acid ($C_2H_4O_2$ or $CH_3 \cdot COOH = 60.03$).

SOURCE.—By the oxidation of Ethyl Alcohol or by the destructive distillation of wood.

CHARACTERS.—A clear, colorless liquid, having a strong, characteristic vinegar-like odor, a sharply acid taste, and a strongly acid reaction. Sp. gr., about 1.045. Miscible, in all proportions, with water or alcohol.

IMPURITIES.—Heavy metals, copper, sulphuric, formic, sulphurous and hydrochloric acids.

Acetic Acid is used to make Syrupus Ipecacuanhæ.

Preparation

Acidum Aceticum Dilutum.—Diluted Acetic Acid. Abv.—Acid. Acet. Dil. Acetic Acid, 120; distilled water 610. Sp. gr., about 1.008. It should contain not less than 5.7 per cent., nor more than 6.3 per cent. of Acetic Acid.

Dose, 2 mils (30 ♏).

6. ACIDUM ACETICUM GLACIALE.—Glacial Acetic Acid. Abv.—Acid. Acet. Glac. A liquid containing not less than 99 per cent. of Acetic Acid ($C_2H_4O_2$ or $CH_3 \cdot COOH = 60.03$).

SOURCE.—Distil dry Sodium Acetate with strong Sulphuric Acid. $NaC_2H_3O_2 + H_2SO_4 = HC_2H_3O_2 + NaHSO_4$.

CHARACTERS.—A clear, colorless liquid, of a strong, vinegar-like odor, and a very pungent, acid taste. Sp. gr., from 1.047 to 1.050. It has the same impurities as Acetic Acid.

7. ACIDUM CITRICUM.—Citric Acid. Abv.—Acid. Cit. $H_3C_6H_5O_7 + H_2O = 210.08$. A tribasic organic acid $[C_3H_4(OH)(COOH)_3 + H_2O]$, usually prepared from the juice of limes or lemons. It should contain not less than 99.5 per cent. of Citric Acid.

SOURCE.—Found in the fruits of the Lime (*Citrus Bergamia*) and Lemon (*Citrus Medica Limonum*). Chalk is added to the boiling juice, usually lemon juice, $2H_3C_6H_5O_7 + 3CaCO_3 = Ca_3(C_6H_5O_7)_2 + 3CO_2 + 3H_2O$. The precipitated Calcium Citrate is boiled with Sulphuric Acid. After filtration and evaporation, Citric Acid crystallizes out. $Ca_3(C_6H_5O_7)_2 + 3H_2SO_4 = 2H_3C_6H_5O_7 + 3CaSO_4$.

CHARACTERS.—Colorless, translucent, right-rhombic prisms, or as a white powder; odorless, and having an acid taste; efflorescent in warm air, and deli-

quescent when exposed to moist air. *Solubility.*—In 0.5 part of water; in 0.5 part of boiling water; 1.8 parts of Alcohol; 30 parts of Ether. Citric Acid, like Tartaric Acid, is often used to produce an effervescing mixture with Ammonium, Sodium or Potassium Carbonates, the two solutions being mixed immediately before taking. Carbon Dioxide, which causes the effervescence, is formed thus: $3KHCO_3+H_3C_6H_5O_7=K_3C_6H_5O_7+3CO_2+3H_2O$.

IMPURITIES.—Sulphuric, tartaric and oxalic acids, iron, calcium, lead, heavy metals.

INCOMPATIBLES.—Potassium tartrate, mineral acids, alkaline carbonates, sulphides, acetates.

Citric Acid is used to make Caffeina Citrata, Caffeina Citrata Effervescens, Liquor Magnesii Citratis, Liquor Potassii Citratis, Potassii Citras Effervescens, Sodii Phosphas Effervescens, Syrupus Aurantii, and Syrupus Lactucarii.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Syrupus Acidi Citrici.—Syrup of Citric Acid. Abv.—Syr. Acid. Cit. Citric Acid, 10; Distilled Water, 10; Tincture of Lemon Peel, 10; Syrup to 1000.

8. ACIDUM TARTARICUM.—Tartaric Acid. Abv.—Acid. Tart. $H_2C_4H_4O_6=150.05$. A dibasic organic acid $[C_2H_2(OH)_2(COOH)_2]$, usually prepared from argol. It contains not less than 99.5 per cent. of pure Tartaric Acid.

SOURCE.—Boil Acid Potassium Tartrate with Calcium Carbonate $2KHC_4H_4O_6+CaCO_3=CaC_4H_4O_6+K_2C_4H_2O_6+H_2O+CO_2$. Calcium Chloride is now added, which precipitates more Calcium Tartrate. $K_2C_4H_4O_6+CaCl_2=CaC_4H_4O_6+2KCl$. The Calcium Tartrate is finally decomposed with Sulphuric Acid. $CaC_4H_4O_6+H_2SO_4=H_2C_4H_4O_6+CaSO_4$. Then evaporate the fluid to the sp. gr., of 1.21. Separate the Calcium Sulphate crystals that form. Again evaporate, Tartaric Acid crystallizes out.

CHARACTERS.—Colorless, translucent, monoclinic prisms, or as a white granular or fine powder, odorless, and having an acid taste. *Solubility.*—In 0.75 part of water and in 3.3 parts of alcohol; in about 0.5 part of boiling water; slightly in Ether; almost insoluble in Chloroform.

IMPURITIES.—Oxalic and sulphuric acids, iron, calcium, lead, heavy metals.

INCOMPATIBLES.—Potassium salts, calcium, mercury, lead, vegetable astringents.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Tartaric Acid is used to make Acidum Hydriodicum Dilutum, Caffeina Citrata Effervescens, Potassii Citras Effervescens, Pulvis Effervescens Compositus, and Sodii Phosphas Effervescens.

9. ACIDUM LACTICUM.—Lactic Acid.—Abv. Acid. Lact. A liquid containing Lactic Acid, and lactic anhydrides equivalent to a total of not less than 85 per cent. nor more than 90 per cent. of Lactic Acid ($CH_3{\cdot}CHOH{\cdot}COOH=90.05$).

SOURCE.—Usually obtained by subjecting milk-sugar or grape-sugar to lactic fermentation.

CHARACTERS.—A colorless, or slightly yellow syrupy liquid, nearly odorless, of an acid taste, and absorbing moisture on exposure to damp air. Sp. gr., about 1.206. It is miscible with water, Alcohol or Ether.

IMPURITIES.—Chlorides, sulphates, phosphoric, tartaric, citric, oxalic, or sarcolactic acid, butyric and other fatty acids, glycerin, sugars, heavy metals, organic impurities.

Dose, 2 mils (30 ♏).

Lactic Acid is used in Syrupus Calcii Lactophosphatis.

For the Therapeutics of the Acids *see* p. 470.

CLASS II.—THE ANTISEPTIC ACID

1. ACIDUM BORICUM.—Boric Acid. Abv.—Acid. Bor. This is often improperly called Boracic Acid. $H_3BO_3 = 62.02$. It should contain not less than 99.5 per cent. of Boric Acid [$B(OH)_3$].

SOURCE.—Native from Northern Tuscany, or made by the action of Hydrochloric Acid on Borax by filtration and recrystallization. $Na_2B_4O_7 + 2HCl + 10H_2O = 4H_3BO_3 + 2NaCl + 5H_2O$.

CHARACTERS.—Transparent, colorless scales, of a somewhat pearly lustre, or six-sided, triclinic crystals, or as a white, very bulky powder, slightly unctuous to the touch, odorless, and having a faintly bitter taste. *Solubility.*—In 18 parts of water; 4 of Glycerin; 18 of Alcohol; 4 parts of boiling water and 6 parts of boiling Alcohol.

IMPURITIES.—Chlorides, sulphates, iron, magnesium, calcium, arsenic, heavy metals.

INCOMPATIBLES.—Alkaline hydroxides, carbonates and earths.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparations

1. Glyceritum Boroglycerini.—Glycerite of Boroglycerin. Abv.—Glycer. Boroglyc. *Synonyms.*—Glycerite of Glyceryl Borate. Solution of Boroglyceride. Boric Acid, 310; Glycerin to 1000.

2. Unguentum Acidi Borici.—Ointment of Boric Acid. Abv.—Ung. Acid. Bor. Boric acid, 100; Paraffin, 50; White Petrolatum, 850.

2. SODII BORAS.—Sodium Borate. Abv.—Sod. Bor. $Na_2B_4O_7 + 10H_2O = 382.16$. *Synonyms.*—Borax. Sodium Tetraborate. Sodium Pyroborate. It contains not less than 52.32 per cent. nor more than 54.92 per cent. of anhydrous Sodium Borate, corresponding to not less than 99 per cent. of crystallized salt.

SOURCE.—Native, as a saline incrustation on the shores of certain lakes and as a crystalline deposit at the bottom of the Borax lake of California, or by boiling together Boric Acid and Sodium Carbonate and crystallization. $4H_3BO_3 + Na_2CO_3 = Na_2B_4O_7 + CO_2 + 6H_2O$.

CHARACTERS.—Colorless, transparent, monoclinic prisms, or as a white, powder, odorless and having a sweetish, alkaline taste. *Solubility.*—In 15 parts of water and 0.6 part of boiling water; in 1 part of Glycerin; insoluble in Alcohol.

IMPURITIES.—Sodium carbonate, bicarbonate, nitrate and phosphate.

INCOMPATIBLES.—Mineral acids, metallic and alkaloidal salts, mucilage of acacia.

Dose, 0.750 gm. = 750 milligm. (12 gr.).

Sodium Borate is contained in Unguentum Aquæ Rosæ.

3. **SODII PERBORAS.**—Sodium Perborate. Abv.—Sod. Perbor. It contains not less than 9' per cent. of available oxygen, corresponding to about 86.5 per cent. of $NaBO_3+4H_2O=154.06$.

SOURCE.—Boric Acid and Sodium Peroxide are gradually added to cold water; the precipitate thus formed is treated with a mineral acid and Sodium Perborate crystallizes out.

CHARACTERS.—White, crystalline granules, or as a powder, odorless and having a saline taste. It is stable in cool and dry air, but is decomposed, with the evolution of oxygen, in warm or moist air. *Solubility.*—It is soluble in water.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Boric Acid and Sodium Borate and Perborate *see* p. 318.

DIVISION II: THE METALS

GROUP I

The Alkali Metals: Potassium, Sodium, Lithium, Ammonium

I. POTASSIUM

K = 39.10

1. **POTASSII HYDROXIDUM.**—Potassium Hydroxide. Abv.—Pot. Hydrox. KOH = 56.11. *Synonyms.*—Caustic Potash. Potassium Hydrate. It should contain not less than 85 per cent. of anhydrous Potassium Hydroxide.

SOURCE.—Evaporate Liqour Potassæ, fuse the residue and pour into clean cylindrical moulds, which have been previously warmed.

CHARACTERS.—Dry, white, or nearly white, fused masses, or in sticks, hard and brittle, showing a crystalline fracture; odorless. *Great caution is necessary in handling it,* as it rapidly destroys organic tissues. Exposed to the air, it rapidly absorbes Carbon Dioxide and moisture and deliquesces. *Solubility.*—In about 0.9 part of water and in 3 parts of Alcohol: soluble in 0.6 part boiling water and very soluble in boiling Alcohol.

IMPURITIES.—Potassium carbonate. heavy metals.

Preparation

Liquor Potassii Hydroxidi.—Solution of Potassium Hydroxide. Abv.—Liq. Pot. Hydrox. An aqueous solution, containing not less than 4.5 per cent. of Potassium Hydroxide.

SOURCE.—Dissolve Potassium Hydroxide (of the full strength and quality directed by the U. S. P.), 60, in distilled water, 940.

CHARACTERS.—A clear colorless liquid, odorless, and having, even when diluted, a very acrid and caustic taste, and a strongly alkaline reaction. *It should not be tasted unless largely diluted.* It absorbs Carbon Dioxide from the air. Sp. gr. about 1.046.

INCOMPATIBLES.—Acids, acid salts, metallic salts and preparations of ammonia, belladonna, hyoscyamus and stramonium, the alkaloids of these being decomposed by caustic potash.

Dose, 1 mil (15 ♏).

For the Therapeutics of Potassium Hydroxide *see* p. 364.

2. POTASSII CARBONAS.—Potassium Carbonate. Abv.—Pot. Carb. $K_2CO_3 = 138.20$. *Synonym.*—Salt of Tartar. It should contain, when thoroughly dried, not less than 99 per cent. of Potassium Carbonate [$CO \cdot (OK)_2$]. It contains not more than 15 per cent. of moisture.

SOURCE.—Pearlash, which is a product of the lixiviation of wood ashes, is treated with water, which dissolves little but Potassium Carbonate, and the solution is evaporated.

CHARACTERS.—A white, granular powder, odorless, and having a very strong alkaline taste; very deliquescent. *Solubility.*—In 0.9 part of water and about 0.7 part of boiling water; insoluble in alcohol.

IMPURITIES.—Nitrates, earthy matters, heavy metals.

INCOMPATIBLES.—Acids; acid, alkaloidal, and most metallic salts, ethyl carbamate. The same incompatibles apply to the bicarbonate.

Dose, 1 gm. (15 gr.).

Potassium Carbonate is used in preparing Pilulæ Ferri Carbonatis (in which Ferrous Carbonate is formed), Spiritus Ætheris Nitrosi, Syrupus Rhei, and Syrupus Rhei Aromaticus.

3. POTASSII BICARBONAS.—Potassium Bicarbonate. Abv.—Pot. Bicarb. $KHCO_3 = 100.11$. It should contain not less than 99 per cent. of Potassium Bicarbonate [$CO(OH)(OK)$].

SOURCE.—Pass Carbon Dioxide through a solution of Potassium Carbonate, and let the bicarbonate crystallize out. $K_2CO_3 + CO_2 + H_2O = 2KHCO_3$.

CHARACTERS.—Colorless, transparent, monoclinic prisms, or as a white, granular powder, odorless, having a saline and slightly alkaline taste. Permanent in the air. *Solubility.*—In about 2.8 parts of water at 25°C. (77°F.), and 2 parts at 50°C. (122°F.). At a higher temperature the solution rapidly loses Carbon Dioxide, and, after being boiled, contains only Potassium Carbonate. Almost insoluble in Alcohol.

IMPURITIES.—The carbonate and heavy metals.

Dose, 1 gm. (15 gr.).

Potassium Bicarbonate is used in preparing Liquor Magnesii Citratis, Liquor Potassii Arsenitis, and Liquor Potassii Citratis.

For the Therapeutics of Potassium Carbonate and Bicarbonate *see* p. 368.

4. POTASSII ACETAS.—Potassium Acetate. Abv.—Pot. Acet. $KC_2H_3O_2 = 98.12$. It should contain, when thoroughly dried, not less than 99 per cent. of Potassium Acetate.

SOURCE.—Add Acetic Acid in excess to Potassium Bicarbanate. Evaporate to dryness and fuse the residue. $KHCO_3 + HC_2H_3O_2 = KC_2H_3O_2 + H_2O + CO_2$.

CHARACTERS.—A white powder, or crystalline masses of a satin-like lustre, odorless, or with a faint, acetous odor, and having a warming, saline taste; very deliquescent on exposure to the air. *Solubility.*—In 0.4 part of water, and 2 parts of Alcohol; much more soluble in both liquids at high temperatures.

IMPURITIES.—Arsenic, heavy metals.

INCOMPATIBLES.—Mineral acids. These are incompatible with other acetates also.

Dose, 1 gm. (15 gr.).

5. POTASSII CITRAS.—Potassium Citrate. Abv.—Pot. Cit. $K_3C_6H_5O_7 + H_2O = 324.36$. It should contain not less than 99 per cent. of Potassium Citrate $[C_3H_4(OH)(COOK)_3 + H_2O]$.

SOURCE.—Neutralize Potassium Carbonate with a solution of Citric Acid, and evaporate to dryness. $3K_2CO_3 + 2H_3C_6H_5O_7 = 2K_3C_6H_5O_7 + 3H_2O + 3CO_2$.

CHARACTERS.—Transparent, prismatic crystals, or a white, granular powder; odorless, and having a cooling, saline taste. Deliquescent on exposure to the air. *Solubility.*—In about 0.6 part of water; very soluble in boiling water; almost insoluble in Alcohol, freely soluble in glycerin.

IMPURITIES.—The tartrate and heavy metals.

INCOMPATIBLES.—Alcohol, lead acetate, potassium permanganate in acid solution, silver nitrate.

Dose, 1 gm. (15 gr.).

Preparation

Liquor Potassii Citratis.—Solution of Potassium Citrate. Abv.—Liq. Pot. Cit. Citric Acid, 6; Potassium Bicarbonate, 8; water to 100. The acid and the bicarbonate are dissolved separately and the solutions mixed. It should contain not less than 8 per cent. of anhydrous Potassium Citrate $[C_3H_4(OH)(COOK)_3 = 306.34]$, with small amounts of Citric and Carbonic Acids.

Dose, 16 mils (4 fl. dr.).

6. POTASSII CITRAS EFFERVESCENS.—Effervescent Potassium Citrate. Abv.—Pot. Cit. Eff. Potassium Citrate, 200; Sodium Bicarbonate, 477; Tartaric Acid, 252; Citric Acid, 162.

SOURCE.—The Citric Acid and Tartaric Acid, powdered, are mixed with the Potassium Citrate, after it has been dried and powdered; and the Sodium Bicarbonate is then thoroughly incorporated. The mixture is subjected to a high temperature in an oven, and when, by the aid of careful manipulation with a

wooden spatula, it has acquired a moist consistence, it is rubbed through a sieve and the granules are dried at a temperature not exceeding 54°C. (129°F.).

CHARACTERS.—A fine, white powder, odorless, and having a pleasant, saline taste. *Solubility.*—Completely in water, with effervescence.

Dose, 4 gm. (60 gr.).

For the Therapeutics of Potassium Acetate and Citrate *see* p. 370.

7. POTASSII BITARTRAS.—Potassium Bitartrate. Abv.—Pot. Bitart. $KHC_4H_4O_6 = 188.14$. *Synonym.*—Cream of Tartar. It should contain not less than 99.5 per cent. of Potassium Bitartrate $[C_2H_2(OH)_2(COOH)(COOK)]$.

SOURCE.—Obtained from crude Tartar (argol) purified by boiling water, filtration through charcoal and crystallization.

CHARACTERS.—Colorless or slightly opaque rhombic crystals, or a white, somewhat gritty, powder; odorless, and having a pleasant, acidulous taste. *Solubility.*—In about 155 parts of water and in 16 parts of boiling water; in 8820 parts of Alcohol.

IMPURITIES.—Alum, heavy metals, starch, kaolin, calcium phosphate, and other insoluble matter.

Dose, 2 gm. (30 gr.).

Potassium Bitartrate is contained in Pulvis Jalapæ Compositus.

For the Therapeutics of Potassium Bitartrate *see* p. 372.

8. POTASSII NITRAS.—Potassium Nitrate. Abv.—Pot. Nitras. $KNO_3 = 101.11$. *Synonyms.*—Nitre. Saltpetre. It should contain not less than 99 per cent. of Potassium Nitrate ($NO_3 \cdot OK$).

SOURCE.—Native Saltpetre, purified.

CHARACTERS.—Colorless, transparent, six-sided, rhombic prisms, or a white crystalline powder; odorless, and having a saline taste and producing a cooling sensation in the mouth. Slightly hygroscopic in moist air. *Solubility.*—In 2.8 parts of water and in 0.5 part of boiling water; in 620 parts of Alcohol.

IMPURITIES.—Potassium iodide, chlorate and perchlorate, heavy metals.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Potassium Nitrate *see* p. 374.

9. POTASSII CHLORAS.—Potassium Chlorate. Abv.—Pot. Chlorat. $KClO_3 = 122.56$. It should contain not less than 99 per cent. of Potassium Chlorate ($ClO_3 \cdot OK$). *Great caution should be observed in handling it,* as dangerous explosions are liable to occur when it is heated or subjected to concussion or trituration with organic substances (cork, tannic acid, dust, sugar, etc.), or with Sulphur, Antimony Sulphide, Phosphorus, or other easily oxidizable substances.

SOURCE.—At present the electrolytic method of making the Chlorate is more generally employed. The electric current, passed through a solution of Potassium Chloride, causes the formation of Potassium Hypochlorite which by boiling is converted into Potassium Chlorate and Potassium Chloride.

CHARACTERS.—Colorless, lustrous, monoclinic prisms or plates, or a white granular powder; odorless and having a saline taste. *Solubility.*—In 11.5 parts of water and in 1.8 parts of boiling water; almost insoluble in Alcohol, but soluble in Glycerin.

IMPURITIES.—Heavy metals, nitrates, nitrites.
Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Trochisci Potassii Chloratis.—Troches of Potassium Chlorate. Abv. —Troch. Pot. Chlorat. Potassium Chlorate, 15; Sugar, 60; Tragacanth, 3; water, a sufficient quantity to make 100 troches. Mix the Sugar with the Tragacanth by trituration in a mortar; then transfer the mixture to a sheet of paper, and, by means of a bone or wooden spatula, mix with it the Potassium Chlorate, being careful to avoid unnecessary trituration or pressure that might cause the mixture to ignite or explode. Lastly, with water, form a mass. Each troche contains 0.15 gm. (2½ gr.) of Potassium Chlorate.

For the Therapeutics of Potassium Chlorate *see* p. 376.

10. **POTASSII BROMIDUM,** *see* Bromine, p. 34.

11. **POTASSII ET SODII TARTRAS,** *see* Sodium, p. 63.

12. **POTASSII IODIDUM,** *see* Iodine, p. 37.

13. **POTASSII PERMANGANAS,** *see* Manganese, p. 88.

14. **POTASSII HYPOPHOSPHIS,** *see* Phosphorus, p. 43.

15. **POTASSA SULPHURATA,** *see* Sulphur, p. 41.

II. SODIUM

Na = 23

1. **SODII HYDROXIDUM.**—Sodium Hydroxide. Abv.—Sod. Hydrox. NaOH = 40.01. *Synonyms.*—Caustic Soda. Sodium Hydrate. It should contain not less than 90 per cent. of Sodium Hydroxide.

SOURCE.—Dissolve Sodium Carbonate in boiling distilled water. Slake Lime and dissolve in distilled water, adding this in small portions at a time to the solution of Sodium Carbonate, boil, strain when cold, set aside until clear and remove the clear solution. Evaporate this solution to an oily consistence and pour into moulds. $Na_2CO_3 + Ca(OH)_2 = 2NaOH + CaCO_3$.

CHARACTERS.—Dry, white, or nearly white, fused masses or sticks, hard and brittle, showing a crystalline fracture; odorless. *It should be used with great caution. Solubility.*—In 0.9 part of water and in about 0.3 part of boiling water; very soluble in Alcohol.

IMPURITIES.—Potassium, sodium carbonate and silicate, heavy metals, organic matter, insoluble impurities.

Preparation

Liquor Sodii Hydroxidi.—Solution of Sodium Hydroxide. Abv.—Liq. Sod. Hydrox. *Synonyms.*—Liquor Sodæ. Solution of Soda. An

aqueous solution, containing not less than 4.5 per cent. of the anhydrous Sodium Hydroxide.

SOURCE.—Dissolve Sodium Hydroxide, 56, in distilled water, 944.

CHARACTERS.—A clear, colorless liquid, odorless, and having, when diluted, a very acrid and caustic taste. Sp. gr., about 1.056. *It should not be tasted unless largely diluted.*

IMPURITIES.—As of Sodium Hydroxide.

INCOMPATIBLES.—Acids; acid, alkaloidal, and most metallic salts, ethyl carbamate.

Dose, 1 mil (15 ♏).

For the Therapeutics of Sodium Hydroxide *see* p. 379.

2. SODII CARBONAS MONOHYDRATUS.—Monohydrated Sodium Carbonate. Abv.—Sod. Carb. Monohyd. $Na_2CO_3+H_2O=124.02$. It should contain not less than 99.5 per cent. of Sodium Carbonate.

SOURCE.—By crystallizing ordinary Sodium Carbonate (which contains 10 molecules of water of crystallization) at a temperature above 35°C. (95°F.).

CHARACTERS.—A white, crystalline, granular powder; odorless, and having a strongly alkaline taste. When exposed to air, under ordinary conditions, it absorbs only a slight percentage of moisture; exposed to warm, dry air at or above 50°C. (122°F.) the salt effloresces, and at 100°C. (212°F.) it becomes anhydrous. *Solubility.*—In 3 parts of water and in 1.8 parts of boiling water; in 7 parts of Glycerin; insoluble in Alcohol.

IMPURITIES.—Heavy metals.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Monohydrated Sodium Carbonate is used to prepare Alumini Hydroxidum, Liquor Sodæ Chlorinatæ, Massa Ferri Carbonatis, Spiritus Ætheris Nitrosi, and Suppositoria Glycerini.

For the Therapeutics of Monohydrated Sodium Carbonate *see* p. 380.

3. SODII BICARBONAS.—Sodium Bicarbonate. Abv.—Sod. Bicarb. $NaHCO_3=84.01$. *Synonyms.*—Baking Soda. Soda. It should contain not less than 99 per cent. of Sodium Bicarbonate.

SOURCE.—Made by treating Sodium Chloride at the same time with Ammonia gas and Carbon Dioxide. $NaCl+NH_3+CO_2+H_2O=NaHCO_3+NH_4Cl$.

CHARACTERS.—A white opaque powder; odorless, and having a cooling, mildly alkaline taste. In dry air it is permanent but in moist air it is slowly decomposed.

Solubility.—In 12 parts of water at 15°C. (59°F.); above this temperature the solution gradually loses Carbon Dioxide, and at boiling heat the salt is entirely converted into the normal Carbonate; insoluble in Alcohol.

IMPURITIES.—The carbonate and sulphocyanate; heavy metals.

INCOMPATIBLES.—It is decomposed by acids and acid salts, *e.g.*, bismuth subnitrate.

Dose, 1 gm. (15 gr.).

Sodium Bicarbonate is used to prepare Caffeina Citrata Effervescens, Ferri Carbonas Saccharatus, Potassii Citras Effervescens, Pulvis Effervescens Compositus, and Sodii Phosphas Effervescens.

Preparation

Trochisci Sodii Bicarbonatis.—Troches of Sodium Bicarbonate. Abv.—Troch. Sod. Bicarb. Sodium Bicarbonate, 18; Sugar, 54; Myristica, 1; Mucilage of Tragacanth, a sufficient quantity to make 100 troches. Triturate the Myristica with the Sugar, gradually added, until they are reduced to a fine powder, and mix this intimately with the Sodium Bicarbonate; then with the Mucilage of Tragacanth, form a mass. Each troche contains 0.18 gm. (3 gr.) of Sodium Bicarbonate.

For the Therapeutics of Sodium Bicarbonate *see* p. 381.

4. SODII PHOSPHAS.—Sodium Phosphate. Abv.—Sod. Phos. $Na_2HPO_4+12H_2O=358.24$. *Synonym.*—Sodium Orthophosphate. It contains not less than 39.25 per cent. nor more than 44 per cent. of anhydrous sodium phosphate (di-sodium ortho-phosphate), corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—Digest Bone Ash with Sulphuric Acid; Acid Calcium Phosphate is formed. $Ca_3(PO_4)_2+2H_2SO_4=CaH_4(PO_4)_2+2CaSO_4$. Filter and add Sodium Carbonate to the solution. $CaH_4(PO_4)_2+Na_2CO_3=Na_2HPO_4+H_2O+CO_2+CaHPO_4$. The filtrate is evaporated and the salt is obtained by crystallization.

CHARACTERS.—Large, colorless, monoclinic prisms, or a granular, crystalline salt; odorless, and having a cooling, saline taste. The crystals effloresce on exposure to the air. *Solubility.*—In 2.7 parts of water; insoluble in Alcohol.

IMPURITIES.—Calcium, arsenic, sodium carbonate, heavy metals.

Dose, 4 gm. (60 gr.).

Preparations

1. Sodii Phosphas Exsiccatus.—Exsiccated Sodium Phosphate. Abv.—Sod. Phos. Exsic. A white powder which absorbs moisture readily. Allow crystals of Sodium Phosphate to effloresce for several days in warm air at a temperature of 25° to 30°C. (77° to 86°F.); continue the drying in an oven; raise the temperature very gradually until 100°C. (212°F.) has been reached, and maintain this temperature until the salt ceases to lose weight; powder and sift the residue.

Dose, 2 gm. (30 gr.).

2. Sodii Phosphas Effervescens.—Effervescent Sodium Phosphate. Abv.—Sod. Phos. Eff. Powder Citric Acid, 162, and mix it intimately with Exsiccated Sodium Phosphate, 200, and Tartaric Acid, 252; then thoroughly incorporate Sodium Bicarbonate, 477. Place the mixed powders in an oven heated to between 93° and 104°C. (199.4° and 219.2°F.); when the mixture has acquired a moist consistence, by the aid of careful manipulation with a wooden spatula rub it through a sieve, and dry the granules at a temperature not exceeding 54°C. (129.2°F.). The salt must not come into contact with air containing moisture.

Dose, 10 gm. (150 gr.).

5. SODII SULPHAS.—Sodium Sulphate. Abv.—Sod. Sulph. $Na_2SO_4+10H_2O=322.23$. *Synonym.*—Glauber's Salt. It should contain not less than

43.64 per cent. nor more than 48 per cent. of anhydrous Sodium Sulphate, corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—Neutralize, with Sodium Carbonate, the residue left in the manufacture of Hydrochloric Acid from Salt. $2NaHSO_4+Na_2CO_3=2Na_2SO_4+CO_2+H_2O$.

CHARACTERS.—Large, colorless, transparent, monoclinic prisms or granular crystals; odorless, and having a bitter, saline taste. The salt effloresces rapidly on exposure to air. *Solubility.*—In slightly over one part of water; insoluble in Alcohol; soluble in Glycerin. When heated to about 33°C. (91.4°F.) it melts in its water of crystallization.

IMPURITIES.—Arsenic, heavy metals.

Dose, 15 gm. (240 gr.).

6. POTASSII ET SODII TARTRAS.—Potassium and Sodium Tartrate. Abv.—Pot. et Sod. Tart. $KNaC_4H_4O_6+4H_2O=282.20$. *Synonym.*—Rochelle Salt. It should contain not less than 73.72 per cent. nor more than 77.39 per cent. of anhydrous Potassium and Sodium Tartrate, corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—Add Acid Potassium Tartrate to a hot solution of Sodium Carbonate. $2KHC_2H_4O_6+Na_2CO_3=2KNaC_4H_4O_6+H_2O+CO_2$.

CHARACTERS.—Colorless, transparent, rhombic prisms, or a white powder, odorless, and having a cooling saline taste. The crystals are slightly efflorescent in dry air. *Solubility.*—In 0.9 part of water; almost insoluble in Alcohol.

IMPURITIES.—Ammonia, heavy metals.

INCOMPATIBLES.—Acids, ammonium chloride, barium, calcium and lead salts, magnesium, potassium, or sodium sulphates, silver nitrate.

Dose, 10 gm. (150 gr.).

Preparation

Pulvis Effervescens Compositus.—Compound Effervescing Powder. Abv.—Pulv. Eff. Co. *Synonym.*—Seidlitz Powder. Take Potassium and Sodium Tartrate, 90 gm., and Sodium Bicarbonate, 30 gm.; mix, divide into twelve equal parts, and wrap each part in a separate blue paper. Tartaric Acid, 26 gm., divide into twelve equal parts, and wrap each part in a separate white paper.

Dose.—1 set of two powders.

For the Therapeutics of Sodium Phosphate and Sulphate and of Potassium and Sodium Tartrate *see* p. 383.

7. SODII CITRAS.—Sodium Citrate. Abv.—Sod. Cit. $2Na_3C_6H_5O_7+2H_2O=294.07$. It should contain not less than 98 per cent. of Sodium Citrate.

SOURCE.—Saturate a solution of Citric Acid with Sodium Bicarbonate, evaporate, and allow it to crystallize. $2H_3C_6H_5O_7+6NaHCO_3=2Na_3C_6H_5O_7+6H_2O+6CO_2$.

CHARACTERS.—A white, granular powder or in small crystals; odorless, and having a cooling, saline taste. *Solubility.*—In 1.3 parts of water and 0.6 part of boiling water; insoluble in Alcohol.

IMPURITIES.—The carbonate, chloride and sulphate; heavy metals.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Sodium Citrate *see* p. 390.

8. SODII CHLORIDUM.—Sodium Chloride. Abv.—Sod. Chlorid. NaCl = 58.46. *Synonym.*—Common Salt. It should contain when dried to constant weight not less than 99 per cent. of Sodium Chloride.

SOURCE.—Occurs native.

CHARACTERS.—Colorless, transparent, cubical crystals, or a white, crystalline powder; odorless, and having a purely saline taste. It is usually slightly hygroscopic. *Solubility.*—In 2.8 parts of water and 2.7 parts of boiling water; in 10 parts of glycerin; slightly soluble in Alcohol.

IMPURITIES.—Heavy metals, sodium bromide and iodide.

Dose, 15 gm. (240 gr.).

Preparation

Liquor Sodii Chloridi Physiologicus.—Physiological Solution of Sodium Chloride. Abv.—Liq. Sod. Chlor. Physio. *Synonyms.*—Physiological Salt Solution. Normal Salt Solution. Dissolve Sodium Chloride, 8.5 gm., in sufficient freshly distilled water to measure 1000 mils and filter. Then sterilize the solution by boiling it at least one hour and preserve it in a sterile condition. This solution should not be used after it has been made forty-eight hours.

For the Therapeutics of Sodium Chloride *see* p. 385.

9. SODII SULPHIS EXSICCATUS.—Exsiccated Sodium Sulphite. Abv.—Sod. Sulphis. Exsic. $Na_2SO_3 = 126.07$. It should contain not less than 90 per cent. of Sodium Sulphite.

SOURCE.—Saturate a solution of Sodium Carbonate with Sulphur Dioxide gas. $Na_2CO_3 + SO_2 = Na_2SO_3 + CO_2$.

CHARACTERS.—A white powder, odorless, and having a cooling, saline, sulphurous taste; if exposed to the air it becomes slowly oxidized to the sulphate. *Solubility.*—In 3.2 parts of water; sparingly in Alcohol.

IMPURITIES.—Sodium thiosulphate, arsenic and heavy metals.

Dose, 1 gm. (15 gr.).

10. SODII THIOSULPHAS.—Sodium Thiosulphate. Abv.—Sod. Thiosulph. $Na_2S_2O_3 + 5H_2O = 248.22$. This salt is frequently designated Sodium Hyposulphite. It should contain not less than 63.07 per cent. nor more than 67.48 per cent. of anhydrous Sodium Thiosulphate, corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—By decomposing soluble Calcium Thiosulphate with Sodium Sulphate. $CaS_2O_3 + Na_2SO_4 = Na_2S_2O_3 + CaSO_4$.

CHARACTERS.—Colorless, transparent, monoclinic prisms; odorless and having a cooling, afterwards bitter taste. *Solubility.*—In about 0.5 part of water; at a boiling temperature it is rapidly decomposed; insoluble in Alcohol.

IMPURITIES.—The sulphide, sulphite and bisulphite, calcium, arsenic, heavy metals, caustic alkali and carbonate.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Exsiccated Sodium Sulphite and Sodium Thiosulphate *see* p. 330.

11. **SODII ARSENAS,** *see* Arsenic, p. 46.

12. **SODII BROMIDUM,** *see* Bromine, p. 35.

13. **SODII HYPOPHOSPHIS,** *see* Phosphorus, p. 43.

14. **SODII IODIDUM,** *see* Iodine, p. 37.

15. **SODII PHENOLSULPHONAS,** *see* Phenol, p. 106.

16. **SODII ACETAS.**—Sodium Acetate. Abv.—Sod. Acet. $NaC_2H_3O_2+3H_2O=136.07$. It contains not less than 59.97 per cent. nor more than 62.96 per cent. of anhydrous sodium acetate, corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—From Sodium Carbonate and Acetic Acid. $Na_2CO_3+2HC_2H_3O_2=2NaC_2H_3O_2+H_2O+CO_2$. By evaporation to crystallization.

CHARACTERS.—Colorless, transparent, monoclinic prisms, or a granular, crystalline powder; odorless or having a faint acetous odor and a cooling, saline taste. Efflorescent in warm, dry air. *Solubility.*—In 0.8 part of water and in 19 parts of Alcohol.

IMPURITIES.—Potassium, arsenic, heavy metals.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Sodium Acetate *see* p. 390.

17. **SODII BENZOAS,** *see* Acidum Benzoicum, p. 176.

18. **SODII BORAS,** *see* Acidum Boricum, p. 55.

19. **SODII PERBORAS,** *see* Acidum Boricum, p. 56.

20. **SODII NITRIS,** *see* The Ethers, p. 104.

21. **SODII SALICYLAS,** *see* Acidum Salicylicum, p. 156.

22. **SODII BENZOSULPHINIDUM,** *see* Benzosulphinidum, p. 111.

23. **SODII CACODYLAS,** *see* Arsenic, p. 47.

24. **SODII GLYCEROPHOSPHAS,** *see* Phosphorus, p. 44.

25. **SODII CYANIDUM.**—Sodium Cyanide. Abv.—Sod. Cyanid. $NaCN=49.01$. It should contain not less than 95 per cent. of Sodium Cyanide.

SOURCE.—By precipitation of Mercury from solution of Mercury Cyanide with Sodium Sulphide and evaporation of the filtrate *in vacuo.*

CHARACTERS.—In white, opaque, amorphous pieces, or a white granular powder; odorless when perfectly dry; deliquescent in the air and exhaling the odor of hydrocyanic acid. *Great caution must be used in handling the salt. Solubility.*—Freely in cold water.

IMPURITIES.—Ferrocyanides and sulphocyanates.

Preparation

Acidum Hydrocyanicum Dilutum.—Diluted Hydrocyanic Acid. Abv.—Acid. Hydrocyan. Dil. *Synonym.*—Diluted Prussic Acid.

Scheele's Prussic Acid is a 4 or 5 per cent. solution. An aqueous solution containing not less than 1.9 per cent. nor more than 2.11 per cent., of Hydrocyanic Acid (HCN = 27.02), and not more than 0.1 per cent. of HCl.

SOURCE.—By treating Sodium Cyanide with Sulphuric Acid, by heating in a retort and collecting the Hydrocyanic Acid in distilled water.

CHARACTERS.—A colorless liquid, of a characteristic odor, resembling that of bitter almonds. *It should be tasted with great caution.* It is very unstable; old specimens may be inert.

IMPURITIES.—Sulphuric, and an excess of hydrochloric acid.

INCOMPATIBLES.—Mineral acids, silver, copper and iron salts, red mercuric oxide, sulphides.

Dose, 0.1 mil (1½ ♏).

Hydrocyanic Acid is found in several vegetable drugs, but on account of its chemical relationship it is considered in this place.

For the Therapeutics of Sodium Cyanide and Hydrocyanic Acid *see* p. 597.

26. SODII INDIGOTINDISULPHONAS.—Sodium Indigotindisulphonate. Abv.—Sod. Indigotin. *Synonym.*—Indigo Carmine. Chiefly the Sodium Salt ($C_{16}H_8O_2N_2(SO_3Na)_2 = 466.22$) of Indigotindisulphonic Acid.

SOURCE.—By addition of a Sodium Salt to Indigo Sulphate, washing the precipitate with a solution of the same salt, and expressing.

CHARACTERS.—A blue or dark purple paste. *Solubility.*—Sparingly in water, yielding a dark blue solution; almost insoluble in Alcohol.

IMPURITIES.—Starch, starch iodide, iron ferricyanide or ferrocyanide.

For the Uses of Sodium Indigotindisulphate *see* p. 827.

III. LITHIUM

Li = 6.94

1. LITHII CARBONAS.—Lithium Carbonate. Abv.—Lith. Carb. Li_2CO_3 = 73.88. It contains, when dried to constant weight, not less than 98.5 per cent. of Lithium Carbonate.

SOURCE.—By action of Lithium Chloride upon Ammonium Carbonate, filtration, washing with Alcohol, and drying. $2LiCl + NH_4HCO_3 = Li_2CO_3 + NH_4Cl + HCl$.

CHARACTERS.—A light, white powder; odorless, and having an alkaline taste; permanent in the air. *Solubility.*—In 78 parts of water and 140 parts of boiling water; almost insoluble in Alcohol; soluble, with active effervescence, in diluted acids.

IMPURITIES.—Iron, aluminum, heavy metals, other alkalies.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

2. LITHII CITRAS.—Lithium Citrate. Abv.—Lith. Cit. $Li_3C_6H_5O_7 + 4H_2O = 281.92$. It contains not less than 98.5 per cent. of Lithium Citrate $[C_3H_4(OH)(COOLi)_3]$.

SOURCE.—By action of Lithium Carbonate upon Citric Acid, evaporation and crystallization. $3Li_2CO_3+2H_3C_6H_5O_7=2Li_3C_6H_5O_7+3H_2O+3CO_2$.

CHARACTERS.—A white powder, or in the granular form; odorless, and having a cooling, faintly alkaline taste. It is deliquescent on exposure to moist air. *Solubility.*—In 1.4 parts of water; very slightly soluble in Alcohol.

IMPURITIES.—Iron, aluminum, alkalies, heavy metals.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Lithium Carbonate and Citrate *see* p. 399.

3. **LITHII BROMIDUM,** *see* Bromine, p. 34.

IV. AMMONIUM

$NH_3=17.03$

1. **AQUA AMMONIÆ FORTIOR.**—Stronger Ammonia Water. Abv.—Aq. Ammon. Fort. An aqueous solution of Ammonia containing not less than 27 per cent. nor more than 29 per cent., by weight, of Ammonia. This solution deteriorates on keeping, and should be tested frequently. *Great caution should be used in handling this liquid.*

SOURCE.—Generate Ammonia gas by heating Ammonium Chloride with Slaked Lime, and pass it into water. $2NH_4Cl+Ca(OH)_2=NH_3+2H_2O+CaCl_2$.

CHARACTERS.—A colorless, transparent liquid, having an excessively pungent, characteristic odor, and a very caustic and alkaline taste. *Stronger Ammonia water must never be tasted unless greatly diluted.* Sp. gr., about 0.897.

IMPURITIES.—Sulphates, chlorides, heavy metals, readily oxidizable substances, coal-tar bases, fixed impurities.

INCOMPATIBLES.—Potassium and sodium hydroxides and carbonates, acids and solutions of acid salts, lime water, lead and silver salts. These are also incompatible with other Ammonium preparations.

2. **AQUA AMMONIÆ.**—Ammonia Water. Abv.—Aq. Ammon. *Synonym*—Ammonia. Contains not less than 9.5 per cent. nor more than 10.5 per cent. by weight, of Ammonia dissolved in water.

SOURCE.—The same as for Aqua Ammoniæ Fortior.

CHARACTERS.—Like, but less pungent than the stronger solution. Sp. gr., about 0.958.

Dose, 1 mil (15 ♏).

Ammonia Water is used to make Bismuth and Ammonium Citrate.

Preparations

1. **Linimentum Ammoniæ.**—Ammonia Liniment. Abv.—Lin. Ammon. *Synonyms.*—Volatile Liniment. Hartshorn Liniment. Ammonia Water 250; Sesame Oil, 750.

2. **Spiritus Ammoniæ Aromaticus,** *see* Ammonium Carbonate, p. 68.

For the Therapeutics of Ammonia *see* p. 391.

3. **AMMONII CARBONAS.**—Ammonium Carbonate. Abv.—Ammon. Carb. Approximately $NH_4HCO_3NH_4NH_2CO_2 = 157.12$. *Synonym.*—Bakers' Ammonia. It consists in varying proportions of a mixture of Acid Ammonium Carbonate [$NH_4HCO_3 = 79.05$] and Ammonium Carbamate [$NH_4NH_2CO_2 = 78.07$], and should yield not less than 30 per cent., nor more than 32 per cent. of Ammonia gas. For dispensing purposes only the translucent portions should be used.

SOURCE.—A mixture of Ammonium Chloride and Calcium Carbonate is subjected to sublimation and resublimation. $4NH_4Cl + 2CaCO_3 = 2CaCl_2 + NH_4HCO_3 \cdot NH_4NH_2CO_2 + NH_3 + 2H_2O$.

CHARACTERS.—White, hard, translucent, striated masses, having a strong odor of ammonia, without empyreuma, and a sharp ammoniacal taste. On exposure to the air it loses both Ammonia and Carbon Dioxide, becoming opaque, and is finally converted into friable, porous lumps, or as a white powder. *Solubility.*—Slowly but completely in 4 parts of water. It is decomposed by hot water with elimination of carbon dioxide and ammonia. Alcohol dissolves the carbamate, leaving the acid carbonate.

IMPURITIES.—Ammonium chloride, sulphate and thiosulphate, empyreumatic and non-volatile matters.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

Preparation

Spiritus Ammoniæ Aromaticus.—Aromatic Spirit of Ammonia. Abv.—Sp. Ammon. Arom. Ammonium Carbonate, 34; Ammonia water, 90; Oil of Lemon, 10; Oil of Lavender 1; Oil of Myristica, 1; Alcohol, 700; Distilled water to make 1000. Sp. gr. about 0.900.

Dose, 2 mils (30 ♏).

Aromatic Spirit of Ammonia is used to make Tinctura Guaiaci Ammoniata and Tinctura Valerianæ Ammoniata.

For the Therapeutics of Ammonium Carbonate *see* p. 395.

4. **AMMONII CHLORIDUM.**—Ammonium Chloride. Abv.—Ammon. Chlor. $NH_4Cl = 53.50$. *Synonym.*—Sal Ammoniac. It should contain, when dried to a constant weight, not less than 99.5 per cent. of Ammonium Chloride.

SOURCE.—Neutralize Gas Liquor with Sulphuric Acid, converting all to Ammonium Sulphate. $2NH_4HO + H_2SO_4 = (NH_4)_2SO_4 + 2H_2O$. After crystallization, sublime with Sodium Chloride. $(NH_4)_2SO_4 + 2NaCl = 2NH_4Cl + Na_2SO_4$.

CHARACTERS.—A white, crystalline or granular powder, without odor, having a cooling, saline taste; somewhat hygroscopic. *Solubility.*—In 2.6 parts of water, 100 of Alcohol, 8 of Glycerin and 1.4 parts of boiling water.

IMPURITIES.—The sulphate and sulphocyanate, iron, calcium, barium, heavy metals, empyreumatic and non-volatile matters.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

Preparation

Trochisci Ammonii Chloridi.—Troches of Ammonium Chloride. Abv. —Troch. Ammon. Chlor. Ammonium Chloride, 10; Extract of Gly-

cyrrhiza, 20; Tragacanth, 2; Sugar, 40 gm.; Syrup of Tolu, a sufficient quantity to make 100 troches.

For the Therapeutics of Ammonium Chloride *see* p. 397.

5. **LIQUOR AMMONII ACETATIS.**—Solution of Ammonium Acetate. Abv.—Liq. Ammon. Acet. *Synonym.*—Spirit of Mindererus. An aqueous solution containing not less than 7 per cent. of Ammonium Acetate ($NH_4C_2H_3O_2$ = 77.07), with small amounts of Acetic and Carbonic Acids.

SOURCE.—Ammonium Carbonate, 5 gm., is gradually added to diluted Acetic Acid, 100 mils, and the mixture is stirred until the carbonate is dissolved.

INCOMPATIBLES.—Potassium and sodium hydroxides and carbonates, acids, lime water, lead and silver salts.

Dose, 15 mils (4 fl. dr.).

Solution of Ammonium Acetate is used in preparing Liquor Ferri et Ammonii Acetatis.

For the Therapeutics of Ammonium Acetate *see* p. 398.

6. **AMMONII BENZOAS,** *see* Acidum Benzoicum, p. 175.

7. **AMMONII BROMIDUM,** *see* Bromine, p. 34.

8. **AMMONII IODIDUM,** *see* Iodine, p. 36.

9. **AMMONII SALICYLAS,** *see* Acidum Salicylicum, p. 156.

10. **AMMONII VALERAS,** *see* Valerian, p. 191.

GROUP II

1. The Alkaline Earths: Calcium, Strontium

I. CALCIUM

Ca = 40.07

1. **CRETA PRÆPARATA.**—Prepared Chalk. Abv.—Cret. Præp. $CaCO_3$ = 100.07. *Synonym.*—Drop Chalk.

SOURCE.—From Chalk (native Calcium Carbonate) by levigation, elutriation and drying.

CHARACTERS.—A white to grayish-white, very fine amorphous powder, often formed into conical drops; odorless and tasteless; permanent in the air. *Solubility.*—Almost insoluble in water: insoluble in Alcohol; soluble in diluted Acetic, Hydrochloric, or Nitric acids, with copious effervescence, leaving not more than 2 per cent. of residue.

INCOMPATIBLES.—Acids, alum, ammonium chloride, sulphates, tartar emetic.

Dose, 1 gm. (15 gr.).

Preparations

1. **Pulvis Cretæ Compositus.**—Compound Chalk Powder. Abv.—Pulv. Cret. Co. Prepared Chalk, 30; powdered Acacia, 20; powdered Sugar, 50.

Dose, 2 gm. (30 gr.).

2. **Mistura Cretæ.**—Chalk Mixture. Compound Chalk Powder, 20; Cinnamon Water, 40; Water to make 100.
Dose, 15 mils (4 fl. dr.).

3. **Hydrargyrum cum Creta,** *see* Hydrargyrum, p. 76.

2. **CALCII CARBONAS PRÆCIPITATUS.**—Precipitated Calcium Carbonate. Abv.—Calc. Carb. Præc. $CaCO_3 = 100.07$. It should contain when dried to a constant weight not less than 98 per cent. of Calcium Carbonate.

SOURCE.—From Calcium Chloride and Sodium Carbonate in Solution, and drying the precipitate. $CaCl_2 + Na_2CO_3 = 2NaCl + CaCO_3$.

CHARACTERS.—A fine, white, micro-crystalline powder; odorless and tasteless. *Solubility.*—Nearly insoluble in water; the solubility is increased by the presence of Ammonium salts, and especially by Carbon Dioxide.

IMPURITIES.—Heavy metals, iron, aluminum, phosphates.

INCOMPATIBLES.—The same as for Creta Præparata.

Dose, 1 gm. (15 gr.).

Preparation

Syrupus Calcii Lactophosphatis.—Syrup of Calcium Lactophosphate. Abv.—Syr. Calc. Lactophos. Precipitated Calcium Carbonate, 25; Phosphoric Acid, 36; Lactic Acid, 60; Stronger Orange Flower Water, 50; Sugar, 625; Glycerin, 50; Water, to 1000.
Dose, 10 mils (2½ fl. dr.).

For the Therapeutics of Prepared Chalk and Precipitated Calcium Carbonate *see* p. 404.

3. **CALX.**—Lime. Calcium Oxide. $CaO = 56.07$. *Synonyms.*—Lime. Quicklime. It contains, when in the anhydrous state, not less than 95 per cent. of Calcium Oxide.

SOURCE.—Made by calcining white marble, or the purest varieties of natural Calcium Carbonate, to expel Carbon Dioxide.

CHARACTERS.—Hard, white or grayish-white masses or granules, which in contact with air gradually attract moisture and Carbon Dioxide, and fall to a white powder (slaked lime); odorless and having a caustic taste. *Solubility.*—In about 840 parts of water and in about 1740 of boiling water; insoluble in Alcohol.

IMPURITY.—The carbonate.

Preparations

1. **Liquor Calcis.**—Solution of Calcium Hydroxide. Abv.—Liq. Calc. *Synonym.*—Lime Water. An aqueous solution, which should contain not less than 0.14 per cent. of Calcium Hydroxide, $[Ca(OH)_2 = 74.09]$.
SOURCE.—Made from Lime, 50; slaked in water, by decantation.
IMPURITIES.—Alkalies and their carbonates.
Dose, 15 mils (4 fl. dr.).
Lime Water is contained in Mucilago Acaciæ.

2. **Linimentum Calcis.**—Lime Liniment. Abv.—Lin. Calc. *Synonym.*—Carron Oil. Lime Water, Linseed Oil, of each, one volume. Mix them by agitation.

For the Therapeutics of Lime *see* p. 405.

4. **CALCII CHLORIDUM.**—Calcium Chloride. Abv.—Calc. Chlor. $CaCl_2$ = 110.99. A hydrated form of Calcium Chloride containing not less than 75 per cent. of Calcium Chloride.

SOURCE.—Obtained by neutralizing Hydrochloric Acid with Calcium Carbonate and evaporating. $CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$.

CHARACTERS.—White, slightly translucent, hard fragments, granules or sticks; odorless, having a sharp saline taste, and very deliquescent. *Solubility.*—In 0.62 part of water and 10 parts of Alcohol; in about 2 of boiling Alcohol; in 0.7 part of boiling water.

IMPURITIES.—Arsenic, barium, lead, iron, aluminum, magnesium, phosphates, alkalies.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

5. **CALCII LACTAS.**—Calcium Lactate. Abv.—Calc. Lact. $Ca(C_3H_5O_3)_2 + 5H_2O = 308.23$. The hydrated form of Calcium Lactate. It contains when dried to a constant weight not less than 98 per cent. of Calcium Lactate.

SOURCE.—Sugar in solution, fresh cheese and prepared chalk are mixed together and left in a sunny place for several weeks when Calcium Lactate crystallizes out.

CHARACTERS.—In white, granular masses or powder; odorless and nearly tasteless. It is somewhat efflorescent. *Solubility.*—Soluble in 20 parts of water; almost insoluble in Alcohol.

IMPURITIES.—Magnesium and alkalies.

Dose, 0.500 gm. = 500 milligm (8 gr.).

For the Therapeutics of Calcium Chloride and Lactate *see* p. 406.

6. **CALCII BROMIDUM,** *see* Bromine, p. 34.

7. **CALX CHLORINATA,** *see* Chlorine, p. 33.

8. **CALCII HYPOPHOSPHIS,** *see* Phosphorus, p. 42.

9. **CALCII SULPHIDUM CRUDUM,** *see* Sulphur, p. 41.

10. **CALCII GLYCEROPHOSPHAS,** *see* Phosphorus, p. 44.

II. STRONTIUM

Sr = 87.63.

1. **STRONTII BROMIDUM,** *see* Bromine, p. 35.

2. **STRONTII IODIDUM,** *see* Iodine, p. 38.

3. **STRONTII SALICYLAS,** *see* Acidum Salicylicum, p. 157.

2. Magnesium, Zinc, Mercury

I. MAGNESIUM

$Mg = 24.32$

1. **MAGNESII SULPHAS.**—Magnesium Sulphate. Abv.—Mag. Sulph. $MgSO_4+7H_2O = 246.50$. *Synonym.*—Epsom Salt. It should contain not less than 48.59 per cent. nor more than 53.45 per cent. of anhydrous Magnesium Sulphate corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—It is obtained from Magnesite (native Magnesium Carbonate), by decomposition with Sulphuric Acid. $MgCO_3+H_2SO_4=MgSO_4+H_2O+CO_2$. Treat with water into which Carbon Dioxide is passed, filter and evaporate the filtrate to crystallization.

CHARACTERS.—Small, colorless, rhombic prisms or prismatic needles (very like Zinc Sulphate, but moister) and having a saline, bitter taste, whilst that of the Zinc salt is metallic. It is slowly efflorescent in the air. *Solubility.*—In 1 part water and in 0.2 part of boiling water; almost insoluble in Alcohol.

IMPURITIES.—Arsenic, heavy metals.

INCOMPATIBLES.—Alkalies, arsenates, carbonates, phosphoric acid, lime water, lead acetate, silver nitrate, sulphites, phosphates, tartrates. The same incompatibles apply to other Magnesium salts.

Dose, 15 gm. (240 gr.).

Magnesium Sulphate is contained in Infusum Sennæ Compositum.

2. **MAGNESII CARBONAS.**—Magnesium Carbonate. Abv.—Mag. Carb. A mixture of Magnesium Carbonate and Magnesium Hydroxide, corresponding to not less than 39.2 per cent. of Magnesium Oxide ($MgO = 40.32$) and containing not more than 0.8 per cent. of Calcium Oxide.

SOURCE.—Mix strong, boiling aqueous solutions of Magnesium Sulphate and Sodium Carbonate, and evaporate. $4MgSO_4+4Na_2CO_3+H_2O=(MgCO_3)_4$, $Mg(OH)_2+4Na_2SO_4+CO_2$. Digest with water, filter and dry.

CHARACTERS.—Light, white friable masses, or a bulky white powder, without odor, and having a slight earthy taste; permanent in the air. *Solubility.*—Practically insoluble in water, to which, however, it imparts a slightly alkaline reaction; insoluble in Alcohol, but soluble in dilute acids with effervescence.

IMPURITIES.—Calcium, iron, heavy metals, foreign soluble salts.

Dose, 3 gm. (45 gr.).

Magnesium Carbonate is used to prepare Magnesii Oxidum, Syrupus Picis Liquidæ, Syrupus Tolutanus, and Syrupus Zingiberis.

Preparation

1. **Liquor Magnesii Citratis.**—Solution of Magnesium Citrate. Abv.—Liq. Mag. Cit. Dissolve Magnesium Carbonate, 15; in water, 100; and Syrup, 60; and Oil of Lemon, 0.1 previously triturated with purified talc, 5.; filter, add a solution of Citric Acid, 33, in water, 150; place in a strong bottle; then add enough boiled water to make 350 mils. Drop in Potassium Bicarbonate, 2.5, and immediately stopper the

bottle securely. Shake the solution until the Potassium Bicarbonate is dissolved. Keep the bottle on its side in a cool place. It effervesces when uncorked.

Dose, 350 mils (12 fl. oz.).

2. **Magma Magnesiæ.**—Magnesia Magma. Abv.—Magma Mag. *Synonym.*—Milk of Magnesia. Magnesia Magma yields not less than 6.5 per cent. nor more than 7.5 per cent. of Mg. $(OH)_2$ = 58.34. Magnesium Carbonate, 125; Sodium Hydroxide, 80; Distilled Water to 1000. By solution, mixing, decantation, washing the magma, allowing the precipitate to subside and decantation of the supernatant liquid.

CHARACTERS.—A thick, white liquid containing Magnesium Hydroxide in suspension in water. *Solubility.*—Two mils of Hydrochloric Acid added to 1 mil of Magnesia Magma causes the evolution of not more than a few isolated bubbles and the resulting solution is not more than slightly turbid.

Dose, 10 mils (2½ fl. dr.).

3. **MAGNESII OXIDUM.**—Magnesium Oxide. Abv.—Mag. Oxid. MgO = 40.32. *Synonyms.*—Magnesia. Calcined Magnesia. Light Magnesia. It contains after ignition, not less than 96 per cent. of Magnesium Oxide and not more than 2 per cent. of Calcium Oxide and not more than 10 per cent. of water.

SOURCE.—By heating the official Magnesium Carbonate; water and Carbon Dioxide are given off, and Magnesium Oxide remains behind. $4(MgCO_3)$, $Mg(OH)_2+5H_2O=5MgO+4CO_2+6H_2O$.

CHARACTERS.—A white, very bulky, and very fine powder, without odor, and having an earthy, but not saline, taste. On exposure to the air it slowly absorbs moisture and Carbon Dioxide. *Solubility.*—Almost insoluble in water; insoluble in Alcohol; soluble in dilute acids.

IMPURITIES.—Magnesium carbonate, iron, calcium, heavy metals, foreign soluble salts.

INCOMPATIBLES.—Acids, copaiba (forms a solid mass), water.

Dose, 2 gm. (30 gr.).

Magnesium Oxide is used to prepare Heavy Magnesia *and is contained in* Ferri Hydroxidum cum Magnesii Oxido, Fluidextractum Cascaræ Sagradæ Aromaticum, and Pulvis Rhei Compositus.

4. **MAGNESII OXIDUM PONDEROSUM.**—Heavy Magnesium Oxide. Abv.—Mag. Oxid. Pond. *Synonym.*—Heavy Magnesia. MgO = 40.32. It contains after ignition, not less than 96 per cent. of Magnesium Oxide and not more than 2 per cent. of Calcium Oxide, and not more than 10 per cent. of water.

SOURCE.—From Magnesium Oxide, by trituation for some time in the presence of strong Alcohol, drying, and rubbing to powder.

CHARACTERS.—A white, dense and very fine powder, which should correspond

to the tests for Magnesia, from which it differs in not readily uniting with water to form a gelatinous Hydroxide.

Dose, 2 gm. (30 gr.).

For the Therapeutics of Magnesium Salts *see* p. 401.

5. **TALCUM PURIFICATUM.**— Purified Talc. Abv.—Talc. Purif. *Synonyms.*—French Chalk. Soapstone. A purified, native, hydrous Magnesium Silicate sometimes containing a small amount of Aluminum Silicate.

CHARACTERS.—A very fine white of grayish-white powder, which adheres to the skin, is quite free from grittiness and is slippery to the touch; it is odorless and tasteless. Sp. gr. 2.2 to 2.8.

IMPURITIES.—Aluminum hydroxide, iron, soluble substances.

For the Uses of Purified Talc *see* p. 829.

II. ZINCUM

Zn = 65.37

1. **ZINCUM.**—Zinc. It should contain not less than 99 per cent. of Zinc.

SOURCE.—Roast the native Zinc Sulphide or Carbonate, and reduce the resulting Oxide with Charcoal.

CHARACTERS.—A bluish-white metal, showing a crystalline fracture; in the form of thin sheets, or irregular, granulated pieces, or moulded into thin pencils, or in fine powder; having a specific gravity ranging from 6.9 when it is cast to 7.2 after it is rolled.

IMPURITIES.—Sulphur, arsenic, antimony, phosphorus, cadmium, lead, copper, iron.

2. **ZINCI CHLORIDUM.**—Zinc Chloride. Abv.—Zinc Chlor. $ZnCl_2$ = 136.29. *Synonym.*—Butter of Zinc. It should contain not less than 95 per cent. of Zinc Chloride.

SOURCE.—Digest Zinc and distilled water with Hydrochloric Acid; add Nitric Acid, and heat; after cooling, dissolve in distilled water, and add precipitated Zinc Carbonate; evaporate until a portion of the liquid, withdrawn and cooled, forms an opaque solid. $Zn_2 + 4HCl = 2ZnCl + 2H_2$.

CHARACTERS.—A white, or nearly white, granular powder, or as porcelain-like masses, irregular, or moulded into pencils; odorless; it is so *intensely caustic as to make tasting dangerous*, unless the salt be dissolved in a large quantity of water. It is very deliquescent. *Solubility.*—In 0.25 part of water; in about 1.3 parts of Alcohol; freely soluble in glycerin.

IMPURITIES.—The oxychloride and sulphate, arsenic, cadmium, lead, copper.

INCOMPATIBLES.—Alkalies and their carbonates, acacia, arsenates, cyanides, lime water, lead acetate, silver nitrate, astringent vegetable infusions or decoction, phosphates, sulphides, sulphates, milk. The same incompatibles apply to other Zinc salts.

3. **LIQUOR ZINCI CHLORIDI.**—Solution of Zinc Chloride. An aqueous solution containing not less than 48.5 per cent. nor more than 52 per cent. of Zinc Chloride.

SOURCE.—From Zinc, 240; Hydrochloric Acid, 840; Nitric Acid, 12; Precipitated Zinc Carbonate, 12; Distilled Water to 1000.

CHARACTERS.—It has an astringent, metallic taste, and an acid reaction. Sp. gr. about 1548.

4. ZINCI SULPHAS.—Zinc Sulphate. Abv.—Zinc Sulph. *Synonym.*—White Vitriol. $ZnSO_4+7H_2O=287.55$. It should contain not less than 55.86 per cent. not more than 58.85 per cent. of anhydrous Zinc Sulphate, corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—Treat Zinc with Dilute Sulphuric Acid; filter and add gradually a solution of Chlorine; add Zinc Carbonate, and agitate; filter, slightly acidify with dilute Sulphuric Acid, and evaporate the filtrate.

CHARACTERS.—Colorless, transparent, rhombic crystals, or a granular crystalline powder, without odor, very like Magnesium Sulphate (*see* p. 72), but having an astringent, metallic taste. *Solubility.*—In 0.6 part of water; in 25 parts of Glycerin; insoluble in Alcohol.

IMPURITIES.—Lead, copper, cadmium, arsenic, free acid, zinc chloride.

Dose 1 gm. (15 gr.).

5. ZINCI CARBONAS PRÆCIPITATUS.—Precipitated Zinc Carbonate. Abv.—Zinc Carb. Præc. Precipitated Zinc Carbonate is of somewhat variable composition compounding to not less than 68 per cent. of Zinc Oxide ($ZnO=81.37$).

SOURCE.—Boil together solutions of Zinc Sulphate and Sodium Carbonate. $3ZnSO_4+3Na_2CO_3+2H_2O=2(ZnCO_3)_2Zn(OH)_2+2CO_2+3Na_2SO_4$. Dry the precipitated Zinc Salt.

CHARACTERS.—An impalpable, white powder, without odor or taste. It is permanent in the air. *Solubility.*—Insoluble in water or Alcohol; completely soluble in diluted acids with copious effervescence; also soluble in Ammonia Water.

IMPURITIES.—Copper, lead, arsenic, cadmium, free alkali.

6. ZINCI OXIDUM.—Zinc Oxide. Abv.—Zinc Oxid. $ZnO=81.37$. It should contain not less than 99 per cent. of Zinc Oxide.

SOURCE.—Heat the precipitated Carbonate to redness in a crucible. $2(ZnCO_3)_2Zn(OH)_2=3ZnO+3H_2O+CO_2$.

CHARACTERS.—A very fine, amorphous, white or yellowish-white powder, free from gritty particles, without odor or taste; it gradually absorbs Carbon Dioxide from the air. *Solubility.*—Insoluble in water or Alcohol; completely soluble, without efferescence in diluted acids; also in Ammonia Water.

IMPURITIES.—The same as of the carbonate, with the addition of zinc sulphate and chloride.

Preparation

Unguentum Zinci Oxidi.—Ointment of Zinc Oxide. Abv.—Ung. Zinc Ox. *Synonym.*—Zinc Ointment. Zinc Oxide, 200; Benzoinated Lard, 800. Rub the Zinc Oxide with about one-fourth of the melted Benzoinated Lard, and with this incorporate the remainder of the Benzoinated Lard, previously melted.

7. ZINCI ACETAS.—Zinc Acetate. Abv.—Zinc.Acet. $Zn(C_2H_3O_2)_2+2H_2O=219.45$. It contains not less than 83.16 per cent. nor more than 87.32 per cent. of anhydrous Zinc Acetate, corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—Dissolve Zinc Oxide in Acetic Acid and water, and boil. $ZnO+2HC_2H_3O_2=Zn(C_2H_3O_2)_2+2H_2O$. Zinc Acetate crystallizes out.

CHARACTERS.—Soft, white, six-sided monoclinic plates, of a pearly lustre, having a faintly acetous odor, and in dilute solutions an astringent, metallic taste. *Solubility.*—In about 2.3 parts of water and 1.6 of boiling water; in 30 of Alcohol and about 1 part of boiling Alcohol.

IMPURITIES.—Those of the oxide.

Dose, 0.125 gm. = 125 millgim. (2 gr.).

For the Therapeutics of Zinc Salts *see* p. 522.

8. ZINCI PHENOLSULPHONAS. *See* Phenol, p. 106.

9. ZINCI STEARAS. *See* Acidum Stearicum, p. 257.

10. ZINCI VALERAS. *See* Valerian, p. 191.

III. HYDRARGYRUM

$Hg=200.6$

1. HYDRARGYRUM.—Mercury. Abv.—Hydrarg. *Synonym.*—Quicksilver. It should contain not less than 99.5 per cent. of metallic Mercury.

SOURCE.—Cinnabar, the native Sulphide, is roasted or distilled with Lime; the volatile Mercury is condensed in suitable aludels.

CHARACTERS.—A shining, silver-white metal, liquid at ordinary temperatures, and easily divisible into spherical globules. It is without odor or taste. Sp. gr. about 13.5. *Solubility.*—Insoluble in the ordinary solvents, but it dissolves in Sulphuric Acid when boiled with it, and is completely soluble in Nitric Acid.

IMPURITIES.—Foreign metals.

Preparations

1. Hydrargyrum cum Creta.—Mercury with Chalk. Abv.—Hydrarg. cum Cret. *Synonym.*—Gray powder.

By trituration of Mercury, 38; Prepared Chalk, 57; Clarified honey, 10; with sufficient water to make 100. By keeping, the Mercury is liable to become Mercuric Oxide, which makes the powder more active. *Strength.*—Not less than 37 per cent. nor more than 39 per cent. of Mercury.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. Massa Hydrargyri.—Mass of Mercury. Abv.—Mass. Hydrarg. *Synonyms.*—Blue Mass. Blue Pill. Mercury, 33; Oleate of Mercury, 1; Honey of Rose, 32; Glycyrrhiza, 10; Althæa, 15; Glycerin, 9. *Strength.*—Not less than 32 per cent. nor more than 34 per cent. of Mercury.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

3. Unguentum Hydrargyri.—Mercurial Ointment. Abv.—Ung. Hydrarg. Mercury, 500; Oleate of Mercury, 20; Benzoinated Lard, 250; Prepared Suet, 230. *Strength.*—50 per cent. of Mercury.

4. **Unguentum Hydrargyri Dilutum.**—Blue Ointment. Abv.—Ung. Hydrarg. Dil. (The undiluted Mercurial Ointment was formerly known as Blue Ointment.) Mercurial Ointment, 600; Petrolatum, 400.

2. **HYDRARGYRI OXIDUM RUBRUM.**—Red Mercuric Oxide. Abv.—Hydrarg. Oxid. Rub. $HgO = 216.60$. *Synonym.*—Red Precipitate. It should contain, when dried to constant weight, not less than 99.5 per cent. of Red Mercuric Oxide.

SOURCE.—Dissolve Mercury in diluted Nitric Acid. $3Hg + 8HNO_3 = 3Hg(NO_3)_2 + 2NO + 4H_2O$. Evaporate to dryness. Triturate the Mercuric Nitrate thus formed, with Mercury, and heat. $2Hg(NO_3)_2 + 2Hg = 4HgO + 2N_2O_4$.

CHARACTERS.—Heavy, orange-red, crystalline scales, or a crystalline powder, acquiring a yellow color when finely divided; odorless and having a somewhat metallic taste. *Solubility.*—Almost insoluble in water; insoluble in Alcohol; readily soluble in diluted Nitric Acid, or in Hydrochloric Acid.

IMPURITIES.—Mercuric nitrate, yellow mercuric oxide, chlorides, arsenic, foreign salts, heavy metals.

INCOMPATIBLES.—Mineral acids, hydrated chloral, mercuric chloride.

3. **HYDRARGYRI OXIDUM FLAVUM.**—Yellow Mercuric Oxide. Abv.—Hydrarg. Oxid. Flav. $HgO = 216.80$. It contains when, dried to constant weight, not less than 99.5 per cent. of Yellow Mercuric Oxide.

SOURCE.—Precipitate a solution of Corrosive Mercuric Chloride, 100; with Sodium Hydroxide, 40. $HgCl_2 + 2NaOH = HgO + 2NaCl + H_2O$.

CHARACTERS.—A light orange-yellow, amorphous, heavy, impalpable powder, odorless and having a somewhat metallic taste. It turns darker on exposure to light. *Solubility.*—Almost insoluble in water; insoluble in alcohol; but readily soluble in diluted Nitric Acid, or in Hydrochloric Acid.

IMPURITIES.—Red mercuric oxide, mercuric nitrate, chlorides, arsenic, foreign salts, heavy metals.

Preparations

1. **Unguentum Hydrargyri Oxidi Flavi.**—Ointment of Yellow Mercuric Oxide. Abv.—Ung. Hydrarg. Oxid. Flav. Yellow Mercuric Oxide, 10; Water, 10; Hydrous Wool-Fat, 40; Petrolatum, 40.

2. **Oleatum Hydrargyri.**—Oleate of Mercury. Abv.—Oleat. Hydrarg. Yellow Mercuric Oxide, 25; Alcohol, 20, Oleic Acid, to 100.

Oleate of Mercury is contained in Unguentum Hydrargyri.

4. **HYDRARGYRI CHLORIDUM CORROSIVUM.**—Corrosive Mercuric Chloride. Abv.—Hydrarg. Chlor. Corr. $HgCl_2 = 271.52$. *Synonyms.*—Corrosive Sublimate. Mercuric Bichloride. It should contain not less than 99.5 per cent. of Mercuric Chloride.

SOURCE.—Heat a mixture of Mercuric Sulphate, Sodium Chloride, and Manganese Dioxide. $HgSO_4 + 2NaCl + MnO_2 = HgCl_2 + Na_2SO_4 + MnO_2$. The Corrosive Chloride sublimes and is condensed. The object of the Manganese Dioxide is to prevent the formation of Mercurous Chloride by setting free Chlorine which will convert it into Mercuric Chloride.

CHARACTERS.—Heavy, colorless rhombic crystals, or crystalline masses, or a white powder, odorless, having a characteristic and persistent metallic taste. *Great caution should be used in tasting it.* *Solubility.*—In 13.5 parts of water and 2.1 of boiling water; in 3.8 parts of Alcohol and 1.6 parts of boiling Alcohol; in about 12 parts of Glycerin.

IMPURITIES.—Arsenic, foreign salts and metals.

INCOMPATIBLES.—Alkalies and their carbonates, alkaloids, arsenous salts, bromides, copper and ferrous salts, iodides, lime water, tartar emetic, silver nitrate, lead acetate, albumin, soaps, vegetable preparations containing tannic acid, and in fact most substances.

Dose, 0.003 gm. = 3 milligm. (1/20 gr.).

Preparation

Toxitabellæ Hydrargyri Chloridi Corrosive.—Poison Tablets of Corrosive Mercuric Chloride. Abv.—Toxitabel. Hydrarg. Chlor. Corr. *Synonyms.*—Corrosive Sublimate Tablets. Bichloride Tablets.

Tablets of an angular shape (not discoid), each having the word "POISON" and the skull and crossbones design distinctly stamped upon it. Each tablet weighs about 1 gm. (15.4 gr.) and contains not less than 0.45 gm. (7 gr.) nor more than 0.55 gm. (8½ gr.) of Corrosive Mercuric Chloride, the remainder consisting chiefly of Sodium Chloride. The tablets are to be colored blue, preferably with Sodium Indigotinsulphonate and are to be dispensed in securely stoppered glass containers on the exterior of which is placed a red label bearing the word "POISON" and a statement indicating that the tablets contain the required amount of Corrosive Mercuric Chloride.

5. HYDRARGYRI CHLORIDUM MITE.—Mild Mercurous Chloride. Abv.—Hydrarg. Chlor. Mit. $HgCl = 236.06$. *Synonyms.*—Calomel. Mercury Protochloride. Mercury Subchloride. It should contain, when dried to constant weight, not less than 99.6 per cent. of Mercurous Chloride.

SOURCE.—Rub Mercury with Mercuric Sulphate to form Mercurous Sulphate. Add Sodium Chloride, and then heat, the Calomel sublimes. $Hg_2SO_4 + 2NaCl = 2HgCl + Na_2SO_4$.

CHARACTERS.—A white, impalpable powder, becoming yellowish-white on being triturated with strong pressure and showing only small crystals when viewed under a lens having a magnifying power of 100 diameters. It is odorless and tasteless. *Solubility.*—Insoluble in water, Alcohol, Ether, or cold dilute acids.

IMPURITIES.—Mercuric chloride, ammoniated mercury, arsenic, heavy metals, foreign salts.

INCOMPATIBLES.—Alkalies, mineral acids, citric and hydrocyanic acids, chlorides and most of the substances incompatible with mercuric chloride.

Dose (laxative), 0.15 gm. = 15 milligm. (2½ gr.); (alterative) 0.015 gm. = 15 milligm. (¼ gr.).

Preparation

Pilulæ Catharticæ Compositæ.—Compound Cathartic Pills. Mild Mercurous Chloride, 60; Compound Extract of Colocynth, 80; Resin of Jalap, 20; Gamboge, 15 gm.; Diluted Alcohol, a sufficient quantity, to make 1000 pills.

Dose, 2 pills.

6. HYDRARGYRI IODIDUM RUBRUM.—Red Mercuric Iodide. Abv.—Hydrarg. Iod. Rub. *Synonyms.*—Red Mercuric Iodide. Mercury Biniodide. $HgI_2 = 454.44$. It should contain, when dried to constant weight, not less than 99 per cent. of Mercuric Iodide.

SOURCE.—Mix Corrosive Mercuric Chloride, 40; dissolved in distilled water, 800, and Potassium Iodide, 50, dissolved in distilled water, 800, with distilled water, 2000. Filter and dry the precipitated Red Iodide. $HgCl_2 + 2KI = HgI_2 + 2KCl$.

CHARACTERS.—A scarlet-red, amorphous powder, odorless and nearly tasteless. *Solubility.*—Almost insoluble in water; soluble in 115 parts of Alcohol, 120 of Ether, and 910 of Chloroform; in 20 of boiling Alcohol; also in solutions of the soluble iodides, mercuric chloride, sodium thiosulphate, and hot solutions of the alkali chlorides.

IMPURITIES.—Chlorides and iodides, mercuric chloride.

INCOMPATIBLES.—The same as of Corrosive Mercuric Chloride.

Dose, 0.003 gm. = 3 milligm. (1/20 gr.).

Preparation

Liquor Arseni et Hydrargyri Iodidi.—Solution of Arsenous and Mercuric Iodides. Abv.—Liq. Arsen. et. Hydrarg. Iod. *Synonym.*—Donovan's Solution. Dissolve Arsenous Iodide, 10, and Red Mercuric Iodide, 10, in distilled water, 150. Filter, and pass sufficient distilled water through the filter to make 1000.

CHARACTERS.—A clear or pale yellowish liquid, having a disagreeable, metallic taste. *Strength.*—1 per cent. of each Iodide.

Dose, 0.1 mil (1½ ♏).

7. HYDRARGYRI IODIDUM FLAVUM.—Yellow Mercurous Iodide. Abv.—Hydrarg. Iod. Flav. $HgI = 327.52$. *Synonyms.*—Green Mercurous Iodide. Mercury Protiodide. It should contain not less than 99 per cent. of Mercurous Iodide.

SOURCE.—By pouring a solution of Potassium Iodide, 16, in distilled water, 32, into a solution of Mercurous Nitrate (obtained from Mercury treated by a solution of Nitric Acid in distilled water, by filtration), 40, in Nitric Acid, 6, and distilled water, 650. The precipitate is washed and dried. $Hg(NO_3) + 2KI = 2HgI + KNO_3$.

CHARACTERS.—A bright yellow, amorphous powder, odorless and tasteless. *Solubility.*—Almost insoluble in water, and wholly insoluble in Alcohol or Ether.

IMPURITY.—Mercuric Iodide.

INCOMPATIBLES.—The same as of Mild Mercurous Chloride.

Dose, 0.010 gm. = 10 milligm. (1/6 gr.).

8. UNGUENTUM HYDRARGYRI NITRATIS.—Ointment of Mercuric Nitrate. Abv.—Ung. Hydrarg. Nit. *Synonym.*—Citrine Ointment.

SOURCE.—Mix a hot solution of Mercury, 7, in Nitric Acid, 17.5, with Lard, 76.

9. HYDRARGYRUM AMMONIATUM.—Ammoniated Mercury. Abv.—Hydrarg. Ammon. $HgNH_2Cl = 252.09$. *Synonym.*—White Precipitate. It should contain not less than 78 nor more than 80 per cent. of Metallic Mercury.

SOURCE.—Mix Corrosive Mercuric Chloride, 100, dissolved in distilled water, 2000, with Ammonia Water, 150. $HgCl_2 + 2NH_4OH = HgNH_2Cl + NH_4Cl + 2H_2O$. Filter and wash the precipitated Ammoniated Mercury with a mixture of Ammonia Water, 20, and distilled water, 400.

CHARACTERS.—White, pulverulent pieces, or a white amorphous powder; odorless and having an earthy, afterwards styptic and metallic taste. *Solubility.*—Insoluble in water or Alcohol; readily soluble in warm Hydrochloric, Nitric or Acetic Acid, and in a cold solution of Ammonium Carbonate.

IMPURITIES.—Mercurous salts, carbonates, arsenic, heavy metals, foreign salts.

INCOMPATIBLES.—Acids, alkalies, bromine, chlorine, iodine, lime water.

Preparation

Unguentum Hydrargyri Ammoniati.—Ointment of Ammoniated Mercury. Abv.—Ung. Hydrarg. Ammon. *Synonym.*—White Precipitate Ointment. Ammoniated Mercury, 10; White Petrolatum, 50; Hydrous Wood-Fat, 40.

10. HYDRARGYRI SALICYLAS.—Mercuric Salicylate. Abv.—Hydrarg. Salicyl. *Synonym.*—Mercuric Subsalicylate. A compound of Mercury and Salicylic Acid containing not less than 54 per cent. nor more than 59.5 per cent. of Mercury.

SOURCE.—From Mercuric Oxide by digestion in boiling water with Salicylic Acid on a water-bath, filtration, washing and drying the precipitate.

CHARACTERS.—A white, slightly yellowish or slightly pinkish powder; odorless and tasteless. *Solubility.*—Nearly insoluble in water or Alcohol; dissolved by solutions of fixed alkalies or their carbonates; dissolved by warm solutions of the alkali halides with the formation of double salts.

IMPURITIES.—Free salicylic acid, foreign mercury compounds.

Dose, 0.004 gm. = 4 milligm. (1/15 gr.).

For the Therapeutics of Mercury and its Salts *see* p. 279.

3. Copper, Silver, Gold

1. CUPRUM

$Cu = 63.57$

1. CUPRI SULPHAS.—Copper Sulphate. Abv.—Cupr. Sulph. $CuSO_4 + 5H_2O = 249.72$. *Synonyms.*—Blue Vitriol. Bluestone. It should contain not less than 62.97 per cent. nor more than 66.79 per cent. of anhydrous Copper Sulphate, corresponding to not less than 98.5 per cent. of the crystallized salt.

SOURCE.—Heat Copper and Sulphuric Acid together, and dissolve the soluble product in hot water and evaporate. $Cu_2+4H_2SO_4=2CuSO_4+4H_2O+2SO_2$.

CHARACTERS.—Deep blue, triclinic crystals or as a blue granular powder odorless, of a nauseous, metallic taste; slowly efflorescent in the air. *Solubility.*—In about 25 parts of water and 0.5 part of boiling water; in 500 parts of Alcohol and 3.8 of Glycerin.

IMPURITIES.—Iron, aluminum, heavy metals.

INCOMPATIBLES.—Alkalies and their carbonates, lime water, mineral salts (except sulphates), iodides and most vegetable astringents.

Dose, 0.250 gm. = 250 milligm. (4 gr.), as an emetic.

Copper Sulphate is used in preparing Trommer's and Fehling's test for sugar. For the Therapeutics of Copper Sulphate *see* p. 525.

II. ARGENTUM

$Ag=107.88$

1. ARGENTI NITRAS.—Silver Nitrate. Abv.—Arg. Nit. $AgNO_3=169.89$. *Synonym.*—Lunar caustic. It should contain not less than 99.8 per cent. of Silver Nitrate.

SOURCE.—Dissolve Silver in Nitric Acid with the aid of heat. Evaporate and crystallize. $6HNO_3+3Ag_2=6AgNO_3+3H_2$.

CHARACTERS.—Colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in the presence of organic matter; odorless, and having a bitter, caustic and strongly metallic taste. *Solubility.*—In 0.4 part of water and 0.1 part of boiling water; in 30 parts of Alcohol and 6.5 of boiling Alcohol.

IMPURITIES.—Copper, lead, foreign salts.

INCOMPATIBLES.—Alkalies and their carbonates, chlorides, iodides, sulphates, copper salts, morphine salts, oils, hypophosphites, acids (except nitric and acetic) solutions of arsenic, astringent infusions.

Dose, 0.010 gm. = 10 milligm. (⅙ gr.).

Preparation

Argenti Nitras Fusus.—Moulded Silver Nitrate. Abv.—Arg. Nit. Fus. *Synonym.*—Lunar caustic. It should contain not less than 94.8 per cent. of Silver Nitrate.

SOURCE.—By melting Silver Nitrate, 100; Hydrochloric Acid, 4; cooling in moulds.

CHARACTERS.—A white, hard solid, generally in the form of pencils or cones showing a fibrous fracture, becoming gray or grayish-black on exposure to light; odorless, and having a bitter, caustic and strongly metallic taste. *Solubility.*—Soluble, with the exception of about 5 per cent. of Silver Chloride (which should be completely soluble in Ammonia Water), in 0.4 part of water and in slightly more than 0.1 part of boiling water; in 30 parts of Alcohol and 6.5 parts of boiling Alcohol.

2. **ARGENTI OXIDUM.**—Silver Oxide. Abv.—Arg. Oxid. $Ag_2O = 231.76$. It should contain not less than 99.6 per cent. of Silver Oxide. It must not be triturated with readily oxidizable or combustible substances, and must not be brought into contact with Ammonia.

SOURCE.—Shake a solution of Silver Nitrate with a solution of Potassa and wash the precipitate. $2AgNO_3 + 2KOH = Ag_2O + 2KNO_3 + H_2O$.

CHARACTERS.—A heavy, dark, brownish-black powder, easily reduced by exposure to light; odorless and having a metallic taste. *Solubility.*—Slightly in water; insoluble in Alcohol; it is dissolved by Nitric Acid.

IMPURITIES.—The carbonate and chloride, and the impurities of Silver Nitrate.

INCOMPATIBLES.—Antimony and arsenic sulphides, chlorides, bismuth, copper, iron and mercury salts, and organic substances, especially creosote, for it rapidly oxidizes them and forms explosive compounds.

Dose, 0.60 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Silver Salts *see* p. 519.

III. AURUM

$Au = 197.2$

AURI ET SODII CHLORIDUM.—Gold and Sodium Chloride. Abv.—Aur. et Sod. Chlor. A mixture of equal parts by weight of anhydrous Gold Chloride ($AuCl_3 = 303.58$) and anhydrous Sodium Chloride ($NaCl = 58.46$), representing, when dried, not less than 30 per cent. of metallic Gold.

CHARACTERS.—An orange-yellow powder, odorless, having a saline and metallic taste; deliquescent when exposed to damp air. *Solubility.*—Very soluble in water. Alcohol or Ether dissolves the Gold Chloride leaving the Sodium Chloride.

IMPURITIES.—Free hydrochloric acid, metallic impurities.

INCOMPATIBLES.—Alkalies, arsenites, hypophosphorous and sulphurous acids, ferrous and mercurous salts, potassium iodide, organic substances, and vegetable infusions.

Dose, 0.005 gm. = 5 milligm. (1/12 gr.).

For the Therapeutics of Gold and Sodium Chloride *see* p. 822.

GROUP III

The Earth Metals: Aluminum, Cerium

I. ALUMINUM

$Al = 27.1$

1. **ALUMEN.**—Alum. Potassium Alum, $AlK(SO_4)_2 + 12H_2O = 474.53$ or Ammonium Alum, $AlNH_4(SO_4)_2 + 12H_2O = 453.47$. It should contain not less than 99.5 per cent. of the Salt. The label must state whether the Salt is Potassium or Ammonium Alum.

SOURCE.—Made from Alum Slate or Shale (a mixture of Aluminum Silicate and Iron Sulphide) by roasting and exposing to the air. By lixiviating the heaps with water, Sulphuric Acid, Aluminum and Iron Sulphates are obtained in solution. This solution is concentrated, and while hot mixed with Potassium Chloride, which, reacting upon the Ferric Sulphate, yields Potassium Sulphate and Ferric Chloride, while the Alum separates on cooling as a crystalline powder. It is then purified by recrystallization.

CHARACTERS.—Both occur in large, colorless crystals, or in crystalline fragments, or as white powder; odorless, and having a sweetish and strongly astringent taste. *Solubility.*—Ammonium Alum is somewhat less soluble in water than is Potassium Alum. Potassium Alum is soluble in 7.2 parts of water and 0.3 part of boiling water; freely in warm Glycerin; insoluble in Alcohol.

IMPURITIES.—Iron, heavy metals.

INCOMPATIBLES.—Alkalies, carbonates, lime, lead, mercury, and iron salts, magnesia, phosphates, sodium borate, tartrates, tannic acid.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Alumen Exsiccatum.—Exsiccated Alum. Abv.—Alum. Exsic. *Synonyms.*—Burnt Alum. Dried Alum. It should contain not less than 96.5 per cent. of anhydrous Ammonium or Potassium Alum. The label of the container should state whether it is made from Ammonium or Potassium Alum.

SOURCE.—Heat 100 parts of Alum with moderate heat till aqueous vapor ceases to be disengaged, and it is reduced to 55 parts.

CHARACTERS.—A white, granular powder, without odor, possessing a sweetish, astringent taste, and attracting moisture on exposure to the air. *Solubility.*—Slowly but completely soluble in about 20 parts of water, and quickly soluble in 1.5 parts of boiling water; insoluble in Alcohol.

2. **ALUMINI HYDROXIDUM.**—Aluminium Hydroxide. Abv.—Alum. Hydrox. $Al(OH)_3 = 78.12$. *Synonym.*—Hydrated Alumina. A compound consisting principally of Aluminum Hydroxide.

SOURCE.—By separate solutions of Alum, 100 and Monohydrated Sodium Carbonate, 45, in water, and heating to boiling. Mix the hot solutions, wash the precipitate with hot water, dry and reduce to a fine powder.

CHARACTERS.—A white, bulky amorphous powder; odorless, tasteless, and permanent in dry air. *Solubility.*—Insoluble in water or Alcohol, but completely dissolved by Hydrochloric or Sulphuric Acid and by the fixed alkali hydroxides.

IMPURITIES.—The sulphate, iron, alkali salts, heavy metals.

For the Therapeutics of Aluminum Salts *see* p. 528.

II. CERIUM

Ce = 140.25

CERII OXALAS.—Cerium Oxalate. Abv.—Cerii. Oxal. It consists chiefly of a mixture of the oxalates of Cerium, Didymium and Lanthanum, and of other

associated elements. Many specimens do not contain more, and generally less, than 60 per cent. of Cerium Oxalate.

SOURCE.—The powdered mineral is heated with concentrated Sulphuric Acid, ignited, then dissolved in dilute Nitric Acid and treated with Hydrogen Sulphide to remove copper, etc.; Hydrochloric Acid is added to prevent precipitation of the Calcium salt, and the cerite metals are precipitated as oxalates by Oxalic Acid. The residue is purified by calcination and solution, reduced to Cerous Sulphate by Sodium Thiosulphate, and the Oxalate precipitated by Oxalic Acid.

CHARACTERS.—A fine, white or slightly pink powder, without odor or taste. *Solubility.*—Insoluble in water, Alcohol or Ether and in solutions of Potassium or Sodium Hydroxide; soluble in hot diluted Sulphuric or Hydrochloric Acid.

IMPURITIES.—Aluminum, zinc, arsenic, carbonates, heavy metals.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

For the Therapeutics of Cerium Oxalate *see* p. 652.

GROUP IV

Lead, Bismuth, Chromium, Uranium, Manganese

I. PLUMBUM

Pb = 207.10

1. **PLUMBI OXIDUM.**—Lead Oxide. Abv.—Plumb. Oxid. PbO = 223.10. *Synonym.*—Litharge. It should contain not less than 96 per cent. of Lead Oxide.

SOURCE.—Made by roasting Lead in air.

CHARACTERS.—A heavy, yellowish or reddish-yellow powder, or minute scales, without odor or taste. *Solubility.*—Almost insoluble in water, to which, however, it imparts a faintly alkaline reaction; insoluble in Alcohol, but dissolved by Acetic or diluted Nitric Acid, and in warm solutions of the fixed alkali hydroxides.

IMPURITIES.—Copper, iron, lead carbonate, silicates, barium sulphate.

Lead Oxide is used to make Liquor Plumbi Subacetatis.

Preparations

1. **Emplastrum Plumbi.**—Lead Plaster. Abv.—Emp. Plumb. *Synonym.*—Diachylon Plaster. Lead Oxide, 1000; is sifted upon Olive Oil, 1000; and Lard, 1000; heated together; boiling water, 350 is added and the whole boiled until a pliable and tenacious mass is formed. Wash the mass with warm water to remove the Glycerin. Finally knead the mass until it is free from water, roll it into cylindrical forms of proper size and wrap them in paper.

Lead Plaster is contained in Emplastrum Resinæ.

2. **Unguentum Diachylon.**—Diachylon Ointment. Abv.—Ung. Diachyl. Lead Plaster, 50; Oil of Lavender, 1; Olive Oil, 49.

2. PLUMBI ACETAS.—Lead Acetate. Abv.—Plumb. Acet. $Pb(C_2H_3O_2) + 3H_2O = 379.20$. *Synonym.*—Sugar of Lead. It should contain not less than 85.31 per cent. and not more than 89.57 per cent. of anhydrous Lead Acetate, corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—Metallic Lead is dissolved, in the presence of air, in Acetic Acid. $PbO + 2C_2H_4O_2 + 2H_2O = Pb(C_2H_3O_2)_2 + 3H_2O$. To obtain well-defined crystals the solution must have a distinctly acid reaction.

CHARACTERS.—Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white, crystalline masses or granular crystals, having a faintly acetous odor and a sweetish, astringent, afterwards metallic taste. Efflorescent, and absorbing Carbon Dioxide, on exposure to the air. *Solubility.*—In 1.4 parts of water and 0.5 part of boiling water; in 38 parts of Alcohol.

IMPURITIES.—Lead carbonate, iron, copper, zinc, salts of the alkali metals, and those of magnesium, calcium, zinc and iron.

INCOMPATIBLES.—Hard water, mineral acids and salts, alkalies, lime water, potassium iodide, hydrated chloral, phenol, resorcinol, vegetable astringents, preparations of opium, albuminous liquids.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. Liquor Plumbi Subacetatis.—Solution of Lead Subacetate. Abv.—Liq. Plumb. Subacet. *Synonym.*—Goulard's Extract. Lead Acetate, 180, and Lead Oxide, 110, are boiled together in distilled water, to make 1000. An aqueous solution which should contain Lead Subacetate (approximately), $Pb_2O(CH_3 \cdot COO)_2 = 548.25$ corresponding to not less than 18 per cent. of Lead.

2. Liquor Plumbi Subacetatis Dilutus.—Diluted Solution of Lead Subacetate. Abv.—Liq. Plumb. Subacet. Dil. *Synonym.*—Lead Water. Liquor Plumbi Subacetatis, 40, distilled water to 1000. It should contain about 1 per cent. of Lead Subacetate.

For the Therapeutics of Lead Salts *see* p. 512.

II. BISMUTHUM

Bi = 208.0

1. BISMUTHI SUBCARBONAS.—Bismuth Subcarbonate. Abv.—Bism. Subcarb. Approximately $[(BiO)_2CO_3]_2 + H_2O = 1034.02$. It should yield not less than 90 per cent. of Bismuth Oxide.

SOURCE.—Dissolve Purified Bismuth in Nitric Acid and water, decant and filter, mix with Ammonia Water; the precipitate is washed and dissolved in Nitric Acid, and poured into a solution of Sodium Carbonate, the resulting precipitate is collected and washed. The final reaction is $2Bi(NO_3)_3 + 3Na_2CO_3 + H_2O = [(BiO)_2CO_3]_2 + H_2O + 6NaNO_3 + 2CO_2$. The precipitated Carbonate is separated by filtration.

CHARACTERS.—A white or pale yellowish-white powder; odorless and tasteless. *Solubility.*—Insoluble in water or Alcohol, but is completely dissolved by Nitric or Hydrochloric Acid, with copious effervescence.

IMPURITIES.—Lead, arsenic, copper, silver, the sulphate and subnitrate, chlorides, alkalies, alkali earths, and tellurium, the last giving an alliaceous odor to the breath.

INCOMPATIBLES.—Acids, alkaloidal salts, bismuth subnitrate, aluminum, barium, calcium, copper, iron, lead, manganese, silver, strontium and zinc salts, ethyl carbamate.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

2. BISMUTHI SUBNITRAS.—Bismuth Subnitrate. Abv.—Bism. Subnit. Approximately $Bi(OH)_2NO_3 = 304.03$. A basic Bismuth Nitrate of varying chemical composition which yields not less than 79 per cent. of Bismuth Oxide.

SOURCE.—Dissolve Purified Bismuth in Nitric Acid and water, concentrate by evaporation pour in more water, and stir thoroughly, wash and dry the precipitated Subnitrate. $Bi_2 + 6HNO_3 = 2Bi(NO_3)_3 + 3H_2$ and $Bi(NO_3)_3 + H_2O = BiONO_3 + 2HNO_3$.

CHARACTERS.—A white powder, odorless and almost tasteless, and slightly hygroscopic. *Solubility.*—Almost insoluble in water and insoluble in Alcohol; readily dissolves in Nitric or Hydrochloric Acid.

IMPURITIES.—As of the subcarbonate.

INCOMPATIBLES.—Alkali carbonates and hydroxides, calomel, hypophosphites, iodides, sulphur, tannic and gallic acids.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Magma Bismuthi.—Bismuth Magma. Abv.—Magma Bism. *Synonym.*—Milk of Bismuth. Bismuth Magma yields not less than 5.6 per cent. nor more than 6.2 per cent. of Bismuth Oxide ($Bi_2O_3 = 464.00$). Bismuth Subnitrate, 80; Nitric Acid, 120; Ammonium Carbonate, 10; Ammonia water and Distilled water to 1000. By solution, decantation, washing and draining the moist Magma.

CHARACTERS.—A thick white opaque liquid containing Bismuth Hydroxide and Bismuth Subcarbonate in suspension in water. *Solubility.*—Equal volumes of Hydrochloric Acid and Bismuth Magma produce a clear solution.

Dose, 4 mils (1 fl. dr.).

3. BISMUTHI ET AMMONII CITRAS.—Bismuth and Ammonium Citrate. Abv.—Bism. et Ammon. Cit. When dried to a constant weight it yields not less than 46 per cent. nor more than 52 per cent. of Bismuth Oxide.

SOURCE.—Bismuth Citrate is rendered soluble by the presence of Ammonium Citrate.

CHARACTERS.—Shining, pearly or translucent scales, or a white powder; odorless, and having a metallic taste. *Solubility.*—Very soluble in water; sparingly soluble in Alcohol.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

4. BISMUTHI SUBGALLAS.—Bismuth Subgallate. Abv.—Bism. Subgal. Ayproximately $Bi(OH)_2C_7H_3O_5 = 411.06$. *Synonym.*—Dermatol. It should yield not less than 52, nor more than 57 per cent. of Bismuth Oxide.

SOURCE.—Normal Bismuth Nitrate is dissolved in Glacial Acetic Acid and water is added; with this is mixed a solution of Gallic Acid in warm water. Allow the precipitate to subside, decant; wash by decantation with warm water until the washings no longer show an acid reaction; dry at 100°C. (212°F.), and rub to powder.

CHARACTERS.—An amorphous, bright yellow powder, without odor or taste. *Solubility.*—Insoluble in water, Alcohol or Ether; readily soluble, with decomposition, in warm Hydrochloric, Nitric and Sulphuric Acids, also soluble in solutions of the alkali hydroxides.

IMPURITIES.—Free gallic acid and the nitrate. Other impurities as of the subcarbonate.

INCOMPATIBLES.—Acids.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

5. BISMUTHI BETANAPTHOLAS, *see* Betanapthol, p. 109.

6. BISMUTHI SUBSALICYLAS.—Bismuth Subsalicylate. Abv.—Bism. Subsalicyl. Approximately $Bi(OH)_2C_7H_5O_3 = 379.06$. It should yield not less than 62 nor more than 66 per cent. of Bismuth Oxide.

SOURCE.—It is prepared by diluting a Glycerin solution of crystallized Bismuthous Nitrate with water, and decomposing this with a concentrated aqueous solution of Sodium Salicylate; the precipitate is well washed with hot water and carefully dried.

CHARACTERS.—A white, or nearly white, amorphous or crystalline powder; odorless and tasteless. *Solubility.*—Almost insoluble in cold water; upon prolonged boiling with water a portion of the Salicylic Acid passes into solution, with the formation of a more basic Bismuth Salicylate.

IMPURITIES.—Nitrates, free salicylic acid. Other impurities as of the subcarbonate.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Bismuth Salts *see* p. 649.

III. CHROMIUM

Cr. = 52.0

CHROMII TRIOXIDUM.—Chromium Trioxide. Abv.—Chrom. Triox. $CrO_3 = 100.0$. *Synonyms.*—Chromic Anhydride. Chromic Acid. It should contain not less than 95 per cent. of Chromium Trioxide. On account of the danger of serious accidents, great caution should be observed to avoid bringing it into contact with organic substances, such as Tannic Acid, Sugar, Alcohol, Ether, Glycerin and Collodion.

SOURCE.—Dissolve Potassium Dichromate in Sulphuric Acid and water, decant from the Acid Potassium Sulphate, heat with more Sulphuric Acid, cool and crystallize. $K_2Cr_2O_7 + 2H_2SO_4 = 2CrO_3 + 2KHSO_4 + H_2O$.

CHARACTERS.—Small, needle-shaped crystals, or rhombic prisms, of a dark purplish-red color and metallic lustre; odorless; destructive to animal and vegetable tissues; deliquescent in moist air. *Solubility.*—In 0.6 part of water.

IMPURITY.—Sulphuric Acid.

For the Therapeutics of Chromium Trioxide *see* p. 477.

IV. URANIUM

U = 238.5

URANII NITRAS.—Uranium Nitrate. Abv.—Uran. Nit. It contains not less than 98 per cent. of Uranyl Nitrate. $UO_2(NO_3)_2 + 6H_2O = 502.62$.

SOURCE.—From pitchblende which is an impure Uranoso-uranic Oxide or from Uranite, by treatment with concentrated Nitric Acid and removing the other metals from the solution by various methods.

CHARACTERS.—Light yellow prisms; odorless and having a bitter, astringent taste; somewhat efflorescent; radio-active. *Solubility.*—In 1.2 parts of water at 25°C. (77°F.); freely soluble in Alcohol or Ether.

IMPURITIES.—Alkaline earths, iron, manganese, zinc, sulphates, uranous compounds.

Dose, 0.01 gm. = 10 milligm. (⅙ gr.).

For the Therapeutics of Uranium Nitrate *see* p. 820.

V. MANGANUM

Mn = 54.93

1. **MANGANI DIOXIDUM PRÆCIPITATUM.**—Precipitated Manganese Dioxide. Abv.—Mangan. Diox. Præc. Chiefly Manganese Dioxide (MnO_2 = 86.93), with small amounts of other Manganese Oxides, corresponding to not less than 80 per cent. of Manganese Dioxide.

SOURCE.—Manganese Sulphate, 50, is dissolved in distilled water, 1000. Ammonia Water, 250, is diluted with an equal volume of distilled water, and mixed with solution of Hydrogen Dioxide, 250, which has also been diluted with an equal volume of distilled water, and the mixed solutions are slowly poured, with constant stirring, into the solution of Manganese Sulphate. Allow the mixture to stand for one hour, stirring frequently; then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by affusion and decantation with hot distilled water. Collect the precipitate on a plain filter, and continue the washing until the washings no longer have an alkaline reaction and produce no turbidity when mixed with Barium Chloride test solution. Allow the precipitate to drain; than dry it at 150°C. (302°F.).

CHARACTERS.—A heavy, very fine, black powder, without odor or taste. Insoluble in water or Alcohol.

IMPURITIES.—Antimony sulphide, insoluble substances.

INCOMPATIBLES.—Alkalies, carbonates, cyanides and phosphates. The same incompatibles apply to other Manganese salts.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Manganese Dioxide is used for making Corrosive Mercuric Chloride and Potassium Permanganate.

For the Therapeutics of Precipitated Manganese Dioxide *see* p. 802.

2. **POTASSII PERMANGANAS.**—Potassium Permanganate. Abv.—Pot. Permang. $KMnO_4 = 158.03$. It contains when dried to constant weight not less than 99 per cent. of Potassium Permanganate ($MnO_3 \cdot OK$). It must not, when dry or in solution, be brought into contact with organic or other readily oxidizable substances.

SOURCE.—Caustic Potash, Potassium Chlorate and Manganese Dioxide are heated together. $6KOH+KClO_3+3MnO_2=3K_2MnO_4+KCl+3H_2O$. Potassium Manganate is boiled with water till the color changes to purple and the Permanganate is formed. $3K_2MnO_4+2H_2O=2KMnO_4+4KOH+MnO_2$. The liquid is neutralized with Carbon Dioxide and evaporated.

CHARACTERS.—Slender, monoclinic prisms, of a dark purple color, almost opaque by transmitted, and of a blue, metallic lustre by reflected light; odorless, and having, in solution, a taste at first sweet, but afterwards disagreeable and astringent. *Solubility.*—In 13.5 parts of water and in 3.5 parts of boiling water. In contact with Alcohol it is decomposed.

IMPURITIES.—Potassium sulphate, nitrate and chloride.

INCOMPATIBLES.—It is very readily deoxidized in the presence of organic matter. It is usually given as a pill, and should be made up with kaolin or paraffin, or an explosion will very likely take place.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Potassium Permanganate *see* p. 322.

GROUP V

Iron

FERRUM

$Fe=55.84$

1. **FERRUM.**—Metallic Iron. Abv.—Ferr. This is in the form of fine, bright wire.

Metallic Iron is pharmacopœial in two forms, viz., this and reduced iron.

Metallic Iron is used to prepare Liquor Ferri Chloridi and Syrupus Ferri Iodidi.

2. **FERRUM REDUCTUM.**—Reduced Iron. Abv.—Ferr. Reduct. *Synonyms.*—Quevenne's Iron. Iron by Hydrogen. It should contain not less than 90 per cent. of Metallic Iron.

SOURCE.—Hydrogen gas is passed through a hot, closed tube which contains freshly prepared, thoroughly washed Ferric Oxide. $Fe_2O_3+3H_2=Fe_2+3H_2O$.

CHARACTERS.—A very fine, grayish-black, lustreless powder, without odor or taste. *Solubility.*—Insoluble in water or Alcohol.

IMPURITY.—Arsenic.

INCOMPATIBLES.—Oxidizers, such as hydrogen dioxide, and potassium chlorate and permanganate; salts of antimony, bismuth, copper, lead, mercury and silver.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Reduced Iron is used to make Pilulæ Ferri Iodidi.

The following (viz., the Sulphate, the Carbonate, and the Iodide), *are ferrous salts*, that is, salts of the lower Oxide, FeO.

3. **FERRI SULPHAS.**—Ferrous Sulphate. Abv.—Ferr. Sulph. $FeSO_4+7H_2O=278.02$. *Synonyms.*—Green Vitriol. Iron Protosulphate. If impure, Copperas. It should contain not less than 54.36 per cent. nor more than 57.07 per cent. of anhydrous Ferrous Sulphate corresponding to 99.5 per cent.

of the crystallized salt. The crystals should not be oxidized; when thus deteriorated, the salt must not be used for any official purpose.

SOURCE.—Iron Wire is dissolved by boiling in Sulphuric Acid and water. The sulphate is crystallized out. $Fe_2+2H_2SO_4=2FeSO_4+2H_2$.

CHARACTERS.—Pale, bluish-green, monoclinic prisms, without odor, and having a saline, styptic taste; efflorescent in dry air. On exposure to moist air the crystals readily oxidize, and become coated with brownish-yellow, basic Ferric Sulphate. *Solubility.*—In 1.4 parts of water and in 0.4 part of boiling water; insoluble in Alcohol.

IMPURITIES.—Free acid, alkali metals, heavy metals.

INCOMPATIBLES.—Alkalies, carbonates, chromates, ferricyanides, gold, silver and mercuric salts, hydrogen dioxide, permanganates, sulphides, tannic acid. The same incompatibles apply to other Ferrous Salts.

Dose, 0.100 gm. = 100 milligm. (1½ gr.).

Ferrous Sulphate is used to make Ferri Carbonas Saccharatus, Liquor Ferri Subsulphatis, Liquor Ferri Tersulphatis, and Massa Ferri Carbonatis.

Preparations

1. **Ferri Sulphas Exsiccatus.**—Exsiccated Ferrous Sulphate. Abv.—Ferr. Sulph. Exsic. Approximately $2FeSO_4 + 3H_2O = 357.87$.

SOURCE.—Allow the sulphate to effloresce at 40°C. (104°F.) and heat in a porcelain dish until it weighs 64 to 65 parts; then reduce to a fine powder.

CHARACTERS.—A grayish-white powder, slowly but completely soluble in water.

Dose, 0.06 gm. = 60 milligm. (1 gr.)

2. **Ferri Sulphas Granulatus.**—Granulated Ferrous Sulphate. Abv.—Ferr. Sulph. Gran. $FeSO_4+7H_2O=278.02$.

SOURCE.—Dissolve Ferrous Sulphate, 100; in diluted Sulphuric Acid, 5; and Distilled Water, 100; pour upon it Alcohol, 25; and filter, wash and dry the precipitate.

CHARACTERS.—A very pale bluish-green, crystalline powder.

Dose, 0.100 gm. = 100 milligm. (1½ gr.).

3. **Pilulæ Ferri Carbonatis.**—Pills of Ferrous Carbonate. Abv.—Pil. Ferr. Carb. *Synonyms.*—Ferruginous pills. Chalybeate pills. Blaud's pills. Granulated Ferrous Sulphate, 16; Potassium Carbonate, 8; Sugar, 4; Tragacanth, 1; Althæa, 1 gm.; Glycerin and water; to make 100 pills. Each pill contains not less than 0.06 gm. (1 gr.) of Ferrous Carbonate.

Dose, 2 pills.

4. **FERRI CARBONAS SACCHARATUS.**—Saccharated Ferrous Carbonate. Abv.—Ferr. Carb. Sacch. It should contain not less than 15 per cent. of Ferrous Carbonate ($FeCO_3=115.84$).

SOURCE.—Made from Ferrous Sulphate, 50; Sodium Bicarbonate, 35; Sugar of Milk, diluted Sulphuric Acid and distilled water; by solution and filtration.

CHARACTERS.—A greenish-brown powder, gradually becoming oxidized by contact with air, odorless, and having at first, a sweetish, afterwards a slightly ferruginous taste. *Solubility.*—Only partially in water, but is completely dissolved upon the addition of Hydrochloric Acid.

IMPURITY.—Ferrous sulphate.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

5. **MASSA FERRI CARBONATIS.**—Mass of Ferrous Carbonate. Abv.—Mass. Ferr. Carb. *Synonym.*—Vallet's Mass. Ferrous Sulphate, 100; Monohydrated Sodium Carbonate, 46; Clarified Honey, 38; Sugar, 25; Syrup and distilled water to 100. By solution, precipitation and evaporation. It contains not less than 35 per cent. of Ferrous Carbonate.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

6. **SYRUPUS FERRI IODIDI.**—Syrup of Ferrous Iodide. Abv.—Syr. Ferr. Iod. A syrupy liquid, containing not less than 4.75 per cent. nor more than 5.25 per cent. of Ferrous Iodide ($FeI_2 = 309.68$). Iron Wire, 12.5; Iodine, 41.5; Diluted Hypophosphorous Acid, 20; Syrup, 575; and distilled water, to 1000.

CHARACTERS.—A transparent, pale or yellowish-green syrupy liquid, having a sweet, strongly ferruginous taste and an acid reaction. It is unstable. Sp. gr. about 1.35.

IMPURITY.—Free iodine.

Dose, 1 mil (15ɱ).

7. **PILULÆ FERRI IODIDI.**—Pills of Ferrous Iodide. Abv.—Pil. Ferr. Iod. Triturate Reduced Iron, 4, with Iodine 5, and water; add Glycyrrhiza 4, Sugar, 4, Extract of Glycyrrhiza 1, and Acacia 1 gm., with sufficient water, Balsam of Tolu and Ether, and evaporate to make 100 pills. The pills are free from the odor of iodine.

Dose, 2 pills.

The following (viz., the Chloride, the Tersulphate, the Subsulphate and the Hydroxide) *are Ferric Salts*, that is, compounds of the higher Oxide, Fe_2O_3. Most are official in the form of liquors.

8. **FERRI CHLORIDUM.**—Ferric Chloride. Abv.—Ferr. Chlor. *Synonyms.*—Iron Perchloride. Iron Sesquichloride. It contains not less than 20 per cent. of Metallic Iron in the form of a hydrated Ferric Chloride ($FeCl_3 = 162.22$).

SOURCE.—Solution of Ferric Chloride, 100, is evaporated on a water-bath until it has lost half of its weight; it is then set aside in a glass-covered vessel until it forms a crystalline mass. Lastly the salt is broken into pieces.

CHARACTERS.—Orange-yellow, crystalline pieces, odorless, or having a faint odor of Hydrochloric Acid, and a strongly styptic taste. It is deliquescent in moist air. *Solubility.*—In 0.2 part of water; freely in alcohol; soluble in Glycerin and Ether.

IMPURITIES.—The oxychloride, ferrous salts, nitric acid, heavy metals.

INCOMPATIBLES.—Acacia, albumin, alkalies, apomorphine, aloin, hydriodic, gallic and tannic acids, guaiacol, hypophosphites, iodides, guaiac, oils of clove,

cinnamon, pimenta, thyme and wintergreen, morphine, resorcinol, salicylates, sulphides, sulphites and thiosulphates, vegetable decoctions and infusions. The same incompatibles apply to other Ferric Salts.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

9. **LIQUOR FERRI CHLORIDI.**—Solution of Ferric Chloride. Abv.—Liq. Ferr. Chlor. An aqueous solution containing Ferric Chloride ($FeCl_3$ = 162.22) corresponding to not less than 10 per cent. nor more than 11 per cent. of Metallic Iron.

SOURCE.—Dissolve Iron Wire, 125, in Hydrochloric Acid, 680, and water to 1000. $Fe_2+4HCl=2FeCl_2+2H_2$. Nitric Acid is added, and thus the Ferrous is converted into Ferric Chloride. $6FeCl_2+6HCl+2HNO_3=6FeCl_3+4H_2O+2NO$.

CHARACTERS.—A reddish-brown liquid, having a faint odor of Hydrochloric Acid, an acid, strongly styptic taste, and an acid reaction. Sp. gr. from 1.29 to 1.32.

IMPURITIES.—Ferrous salts, the oxychloride, nitric acid, zinc, copper, salts of the fixed alkalies.

Dose, 0.1 mil (1½ ♏).

Preparations

1. **Tinctura Ferri Chloridi.**—Tincture of Ferric Chloride. Abv.—Tr. Ferr. Chlor. A hydro-alcoholic solution containing Ferric Chloride ($FeCl_3$ = 162.22) about 13 per cent. corresponding to not less than 4.48 per cent. of Metallic Iron. Solution of Ferric Chloride, 350; Alcohol to 1000.

CHARACTERS.—A bright, amber-colored liquid, having a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction. Sp. gr. about 1.00.

IMPURITY.—Nitric acid.

Dose, 0.5 mil (8 ♏).

2. **Liquor Ferri et Ammonii Acetatis.**—Solution of Iron and Ammonium Acetate. Abv.—Liq. Ferr. et Ammon. Acet. *Synonym.*—Basham's Mixture. Tincture of Ferric Chloride, 40; Diluted Acetic Acid, 60; Solution of Ammonium Acetate, 500; Aromatic Elixir, 120; Glycerin, 120; water to 1000.

Dose, 15 mils (4 fl. dr.).

10. **LIQUOR FERRI TERSULPHATIS.**—Solution of Ferric Sulphate. Abv.—Liq. Ferr. Tersulph. *Synonym.*—Solution of Iron Tersulphate. An aqueous solution containing normal Ferric Sulphate [$Fe_2(SO_4)_3$ = 399.89], corresponding to not less than 9.5 per cent. nor more than 10.5 per cent. of Metallic Iron.

SOURCE.—A hot solution of Ferrous Sulphate, 500, in Sulphuric Acid, 96, and water, is boiled with Nitric Acid and water to 1000. $6FeSO_4+3H_2SO_4+2HNO_3=3Fe_2(SO_4)_3+4H_2O+2NO$.

CHARACTERS.—A yellowish-brown liquid, almost odorless, and having an acid, strongly styptic taste and an acid reaction; it is miscible with water and Alcohol. Sp. gr. about 1.432.

IMPURITIES.—The subsulphate, ferrous salts, nitric acid.

11. **LIQUOR FERRI SUBSULPHATIS.**—Solution of Ferric Subsulphate. Abv.—Liq. Ferr. Subsulph. *Synonyms.*—Monsel's solution. Solution of Basic Ferric Sulphate. An aqueous solution containing basic Ferric Sulphate corresponding to not less than 13 per cent. nor more than 14 per cent. of Metallic Iron.

SOURCE.—From Ferrous Sulphate, 675; Sulphuric Acid, 65; Nitric Acid, a sufficient quantity. Boil and add distilled water to 1000.

CHARACTERS.—A dark reddish-brown liquid, odorless, or nearly so, and having an acid, strongly styptic taste, and an acid reaction; miscible with water and Alcohol without decomposition. Sp. gr. about 1.548.

IMPURITIES.—The tersulphate, ferrous salts, nitric acid.

Dose, 0.2 mil (3 ♏).

12. **FERRI HYDROXIDUM CUM MAGNESII OXIDO.**—Ferric Hydroxide with Magnesium Oxide. Abv.—Ferr. Hydrox. Cum Mag. Oxid. *Synonyms.*—Arsenic Antidote. Ferric Hydrate with Magnesia. Mix a solution of Ferric Sulphate, 40, with water, 125, and keep the liquid in a large, well-stoppered bottle. Rub Magnesium Oxide, 10, with cold water to a smooth and thin mixture, transfer this to a bottle capable of holding about 1000 mils and fill it with water to about three-fourths of its capacity. When the preparation is wanted for use, shake the Magnesium Oxide mixture until of a thin, creamy consistence, slowly add to it the diluted Solution of Ferric Sulphate, and shake them together until a uniform, smooth mixture results.

For the rapid preparation of this antidote to arsenical poisoning, the diluted Solution of Ferric Sulphate and the mixture of Magnesium Oxide with water, should always be kept on hand, in separate bottles, ready for immediate use.

Dose (arsenical antidote), 120 mils (4 fl. oz.).

The following are scale preparations of Iron, so called because they are dried to form scales. They are not well-defined chemical compounds. They are three; the Phosphate, Iron and Ammonium Citrate, and Iron and Quinine Citrate.

13. **FERRI PHOSPHAS.**—Ferric Phosphate. Abv.—Ferr. Phos. *Synonym.*—Soluble Ferric Phosphate. Ferric Phosphate rendered soluble by the presence of Sodium Citrate. It contains not less than 12 per cent. of Metallic Iron.

SOURCE.—Dissolve Ferric Citrate, 50; in distilled water, 100; add Sodium Phosphate, 55. Evaporate and dry on glass.

CHARACTERS.—Thin, bright green, transparent scales, without odor; and having an acidulous, slightly saline taste. *Solubility.*—Freely and completely in water; insoluble in Alcohol.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

14. **FERRI ET AMMONII CITRAS.**—Iron and Ammonium Citrate. Abv.—Ferr. et Ammon. Cit. *Synonyms.*—Ammonio-Ferric Citrate. Soluble Ferric Citrate. Ferric Citrate rendered more readily soluble by the presence of Ammonia Citrate and containing not less than 16 per cent. nor more than 18 per cent. of Metallic Iron.

SOURCE.—From evaporation of a solution of Ferric Citrate, 100, with Ammonia Water, 40, to consistency of syrup. Dry the precipitate on glass.

CHARACTERS.—Thin, transparent, garnet-red scales, odorless, and having a saline, mildly ferruginous taste; deliquescent in moist air. *Solubility.*—Readily and completely in water; insoluble in Alcohol.

IMPURITIES.—Tartrates or citrates of the alkali metals, iron tartrate, ferrous citrate.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

15. FERRI ET QUININÆ CITRAS.—Iron and Quinine Citrate. Abv.—Ferr. et Amm. Cit. *Synonym.*—Soluble Iron and Quinine Citrate. Iron Citrate and Quinine Citrate, rendered more soluble by the presence the Ammonium Citrate and containing not less than 11.5 per cent. of anhydrous Quinine ($C_{20}H_{24}O_2N_2 = 324.21$) and not less than 13 per cent. of Metallic Iron.

SOURCE.—Dissolve Ferric Citrate, 85, in distilled water, 160 by heating; add Quinine, 12, Citric Acid, 3, previously triturated in distilled water, 20; mix these solutions and stir with Ammonia Water, 50; evaporate to a syrupy consistency and dry on glass.

CHARACTERS.—Thin, transparent scales, of a greenish, golden-yellow color, odorless, and having a bitter, mildly ferruginous taste. It is deliquescent.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

INCOMPATIBLES OF IRON SALTS IN GENERAL.—All substances containing tannic or gallic acid form an intense black with ferric salts. Preparations of iron are therefore incompatible with all vegetable astringent solutions, and the only infusions with which they can be prescribed are infusions of quassia and of calumba. It is frequently forgotten that on account of the presence of tannic acid, both the tincture and infusion of digitalis form an inky mixture with iron preparations. A small quantity of diluted phosphoric acid will serve to clarify such a mixture, though after a few days a slight precipitate of ferric phosphate will be observed. Mucilage of acacia becomes gelatinous from the addition of ferric salts. With ferrous salts, alkalies and their carbonates, lime water, calcium carbonate, and magnesia and magnesium carbonate form green precipitates, and with ferric salts, brown precipitates.

For the Therapeutics of Iron and its Salts *see* p. 407.

SECTION II. ORGANIC MATERIA MEDICA

DIVISION I: THE SYNTHETICS AND ALLIED DRUGS

GROUP I

The Hydrocarbons

Petrolatum, Purified Petroleum Benzin, Paraffin

These have already been considered with Carbon on pp. 48 and 49.

GROUP II

The Alcohols

ALCOHOL

Alcohol is official in the three following forms:

1. **ALCOHOL.** *Synonym.*—Spirit of Wine. A liquid composed of not less than 92.3 per cent., by weight, or 94.9 per cent., by volume, of Ethyl Alcohol ($C_2H_5 \cdot OH = 46.05$).

SOURCE.—Macerate rectified spirit with Anhydrous Potassium Carbonate to remove the water, then again with freshly fused Calcium Chloride, and distil.

CHARACTERS.—A transparent, colorless, mobile and volatile liquid, of a slight, characteristic odor, and a burning taste. It is miscible with water in all proportions, and without any trace of cloudiness; also miscible with Ether and Chloroform. Sp. gr., not above 0.816 at 15.56°C. (60°F.), the standard temperature for Alcohol, or 0.810 at 25°C. (77°F.). Readily volatilized; boils at about 78°C (172.4°F.).

IMPURITIES.—Organic impurities, amyl alcohol, aldehyde, etc., fusel oil constituents.

Alcohol is used to make Chloroform. All spirits are made with Alcohol and all tinctures with Alcohol or Diluted Alcohol. Alcohol is largely employed in making extracts, fluidextracts and various other preparations.

2. **ALCOHOL DILUTUM.**—Diluted Alcohol. Abv.—Alcohol Dil. *Synonyms.*—Proof Spirit. Spiritus Tenuior. A liquid composed of from 41 to 42 per cent., by weight, or from 48.4 to 49.5 per cent., by volume, of Ethyl Alcohol ($C_2H_5 OH = 46.05$). Alcohol, 500 mils; distilled water, 500 mils. If the two liquids are measured at 25°C. (77°F.) the mixture, when cooled to this same temperature, will measure about 970 mils. It can also be prepared by mixing Alcohol 408 gm.; with distilled water, 500 gm.

CHARACTERS.—The same as those of Alcohol. Sp. gr., from 0.935 to 0.937 at the standard temperature for Alcohol and from 0.930 to 0.932 at 25°C. (77F.).

3. **ALCOHOL DEHYDRATUM.**—Dehydrated Alcohol. Abv.—Alcohol Dehyd. *Synonym.*—Absolute Alcohol. A liquid containing not less than 99 per cent. by weight of Ethyl Alcohol.

SOURCE.—By percolation of the strongest and purest Alcohol through recently burned lime, out of contact with the air; then re-distil the percolate *in vacuo*.

CHARACTERS.—A transparent, colorless, mobile and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. It is very hygroscopic. Sp. gr., not higher than 0.798 at 15.6°C. (60°F.) nor above 0.790 at 25°C. (77°F.).

Amount of Ethyl Alcohol by volume in various other important substances

Alcohol deodoratum	contains	95.1		per cent.
Spiritus rectificatus	"	90		"
Rum, Gin, strong liqueurs	"	51	to 59	"
Vinum portense	"	20	to 30	"
Vinum xericum or Madeira	"	16	to 22	"
Champagne	"	10	to 13	"
Burgundy	"	9	to 12	"
Rhine (hock)	"	9	to 12	"
Bordeaux (claret)	"	8	to 12	"
Cider	"	5	to 9	"
Strong Ale or Stout	"	5	to 9	"
Beer or Porter	"	2	to 5	"
Kumyss	"	1	to 3	"

For the Therapeutics of Alcohol *see* p. 733.

GROUP III

The Aldehydes

1. THE HALOGEN DERIVATIVES

Formaldehyde, Paraformaldehyde, Hexamethylenamine, Paraldehyde, Hydrated Chloral, Chloroform, Trichloracetic Acid, Bromoform, Iodoform, Ethyl Chloride, Acetone, Methylthionine Chloride

1. LIQUOR FORMALDEHYDI

SOLUTION OF FORMALDEHYDE. Abv.—Liq. Formaldehyd. *Synonyms.*—Formalin. Formol. An aqueous solution, containing not less than 37 per cent., by weight, of absolute Formaldehyde (CH_2O or $H{\cdot}CHO = 30.02$), an oxidation product of Methyl Alcohol, with varying amounts of the latter to prevent polymerization.

SOURCE.—Formaldehyde, which is a gas soluble in water, is obtained by the oxidation of Methyl Alcohol at a moderately high temperature, or by passing the vapor over red-hot metal.

CHARACTERS.—A clear, colorless, or nearly colorless liquid, having a pungent odor and caustic taste; its vapor acts as an irritant upon the mucous membranes.

On long standing, especially in the cold, it sometimes loses its transparency, the cloudiness being due to the separation of paraformaldehyde. *Solubility.*—Miscible in all proportions with water and Alcohol.

IMPURITIES.—Sulphate, chloride, iron, lead, copper, calcium, formic and other acids.

II. PARAFORMALDEHYDUM

PARAFORMALDEHYDE. Abv.—Paraform. *Synonyms.*—Trioxymethelene. Paraform. It contains not less than 95 per cent. of $(HCHO)_3 = 90.05$, a polymeric form of Formaldehyde.

SOURCE.—By polymerization of strong solutions of Formaldehyde by cold.

CHARACTERS.—White friable masses, or as a powder, having a slight odor of Formaldehyde. On heating it is partly converted into Formaldehyde and partly sublimes unchanged. *Solubility.*—It is slowly soluble in cold water, more readily in hot water with the formation of Formaldehyde; insoluble in Alcohol or Ether; soluble in fixed alkali solutions.

IMPURITIES.—The same as for Formaldehyde.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Formaldehyde and Paraformaldehyde *see* p. 299.

III. HEXAMETHYLENAMINA

HEXAMETHYLENAMINE. Abv.—Hexam. $(CH_2)_6N_4 = 140.14$. *Synonyms.*—Hexamethylene-tetramine. Urotropin. Formin. Aminoform. A condensation product [Hexamethylene-tetramine $(CH_2)_6N_4$] from the action of Ammonia upon Formaldehyde.

SOURCE.—It is obtained by the action of 4 molecules of Ammonia on 6 molecules of Formaldehyde: $4H_3N + 6CH_2O = (CH_2)_6N_4 + 6H_2O$.

CHARACTERS.—Colorless, lustrous, odorless, crystals, or as a white, crystalline powder having, when in aqueous solution, an alkaline reaction. While this substance is odorless at ordinary temperatures, heating evolves a peculiar fishy odor. *Solubility.*—In about 1.5 parts of either cold or boiling water; in 12.5 parts of Alcohol; in 320 parts of Ether.

INCOMPATIBLES.—All acids decompose it in the presence of warmth.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

For the Therapeutics of Hexamethylenamine *see* p. 574.

IV. PARALDEHYDUM

PARALDEHYDE. Abv.—Paraldehyd. $(CH_3CHO)_3$.—A polymer of Acetaldehyde $(CH_3 \cdot CHO)_3 = 132.10$.

SOURCE.—Formed by adding a few drops of concentrated Sulphuric Acid to Aldehyde, which causes the liquid to become hot. On cooling to 0°C. (32°F.), the Paraldehyde solidifies in crystals. When distilled with dilute Sulphuric Acid, Hydrochloric Acid, etc., it is converted into Aldehyde.

CHARACTERS.—A colorless, transparent liquid, having a strong, characteristic, but not unpleasant or pungent odor, and a burning and then a cooling taste. Sp. gr., about 0.990. *Solubility.*—In 8 parts of water and in 17 of boiling water; freely miscible with Alcohol, Chloroform, Ether, and fixed or volatile oils.

IMPURITIES.—Sulphuric and hydrochloric acids, free acid, amyl alcohol, impurities derived from fusel oil.

INCOMPATIBLES.—Alkalies, hydrocyanic acid, iodides, oxidizers.

Dose, 2 mils (30 m).

For the Therapeutics of Paraldehyde *see* p. 769.

V. CHLORALUM HYDRATUM

HYDRATED CHLORAL. Abv.—Chloral. Hydrat. $C_2HCl_3O+H_2O$ or $CCl_3\cdot COH+H_2O=165.4$ *Synonym.*—Chloral Hydrate. A compound of Trichloraldehyde or Chloral ($CCl_3\cdot COH+H_2O$) with the elements of one molecule of water. It should contain not less than 99.5 per cent. of Hydrated Chloral.

SOURCE.—Absolute Alcohol is saturated with dry Chlorine; Aldehyde and Hydrochloric Acid are first formed. $C_2HO_1H+Cl_2=C_2H_4O+2HCl$. By the continued action of the Chlorine Gas 3 atoms of Hydrogen are abstracted from the Aldehyde and replaced by 3 atoms of Chlorine, producing Chloral Hydrate. $C_2H_4O+3Cl_2=C_2HCl_3O+3HCl$. It is purified by Sulphuric Acid and afterwards by Lime.

CHARACTERS.—In rhomboidal, colorless and transparent crystals, which do not readily attract moisture, having an aromatic, penetrating and slightly acrid odor, and a bitterish, caustic taste. It is slowly volatilized when exposed to the air; easily melted by gentle heat. *Solubility.*—In 0.25 part of water; in 1.3 parts of Alcohol; in 1.5 parts of Ether; in 2 parts of Chloroform; very soluble in Olive Oil; freely soluble in Oil of Turpentine. It liquefies when triturated with about an equal quantity of Camphor, Menthol, Phenol or Thymol.

IMPURITIES.—Chloral alcoholate, ethyl carbamate, hydrochloric acid and chlorides.

INCOMPATIBLES.—Acetphenetidin, alcohol, borax, lead acetate, monobromated camphor, phenyl salicylate, potassium iodide and permanganate, quinine, sodium phosphate; all alkalies decompose it.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Hydrated Chloral *see* p. 762.

VI. CHLOROFORMUM

CHLOROFORM. Abv.—Chlorof. *Synonym.*—Trichloromethane. A liquid consisting of not less than 99 nor more than 99.4 per cent., by weight, of absolute Chloroform [$CHCl_3=119.39$] and not less than 0.6 per cent. nor more than 1 per cent. of Alcohol. Care should be taken in vaporizing Chloroform in the presence of a naked flame, as noxious gases are produced.

SOURCE.—From the distillation of Acetone and Chlorinated Lime, from which Chloroform is produced, together with Calcium Acetate, Hydroxide and Chloride. $2C_3H_6O+6Ca(OCl)_2=2CHCl_3+Ca(C_2H_3O_2)_2+2Ca(OH)_2+3CaCl_2$.

CHARACTERS.—A clear, colorless, mobile liquid, of a characteristic, ethereal odor, and a burning, sweet taste. Sp. gr., 1.474 to 1.478. It is not inflammable, but its heated vapor burns with a green flame. *Solubility.*—In 200 times its volume of water, in which it sinks in heavy drops; miscible with Alcohol, Ether, Benzene, Petroleum Benzin, or with fixed or volatile oils.

IMPURITIES.—Chlorides, free chlorine, chlorinated and odorous decomposition products, impurities decomposable by sulphuric acid.

Dose, 0.3 mil (5 ♏).

Preparations

1. **Aqua Chloroformi.**—Chloroform Water. Abv.—Aq. Chlorof. Chloroform and distilled water, by agitation, care being taken that there should always be an excess of Chloroform present.

Dose, 15 mils (4 fl. dr.).

2. **Linimentum Chloroformi.**—Chloroform Liniment. Abv.—Lin. Chlorof. Chloroform, 300; Soap Liniment, 700.

3. **Spiritus Chloroformi.**—Spirit of Chloroform. Abv.—Sp. Chlorof. *Synonym.*—Chloric Ether. Chloroform, 60; Alcohol, to 1000. *Strength.*—6 per cent.

Dose, 2 mils (30 ♏).

For the Therapeutics of Chloroform *see* p. 772.

VII. ACIDUM TRICHLORACETICUM

TRICHLORACETIC ACID. Abv.—Ac. Trichloracet. $C_2HO_2Cl_3 = 163.39$. —A monobasic organic acid which contains not less than 99 per cent. of Trichloracetic Acid ($CCl_3 \cdot COOH = 169.39$).

SOURCE.—Usually obtained by the oxidation of Hydrated Chloral with Nitric Acid.

CHARACTERS.—Colorless, deliquescent, rhombohedral crystals, having a slight characteristic odor. *Solubility.*—In about 0.1 part of water; very soluble in Alcohol, and Ether. The aqueous solution, on boiling, is decomposed with the formation of Chloroform and Carbon Dioxide.

IMPURITIES.—Chlorides and nitric acid.

For the Therapeutics of Trichloracetic Acid *see* p. 473.

VIII. BROMOFORMUM

BROMOFORM. Abv.—Bromof. A liquid consisting of 99 per cent., by weight, of absolute Bromoform ($CHBr_3 = 252.77$), and about 4 per cent. of Dehydrated Alcohol. *Synonym.*—Tribromomethane.

SOURCE.—By the action of Sodium Hypobromite (which is obtained when Bromine is added to a solution of Sodium Hydroxide) on Acetone.

CHARACTERS.—A heavy, transparent, colorless, mobile liquid, with an ethereal odor and a penetrating, sweet taste resembling Chloroform. Sp. gr., 2.595 to 2.620. *Solubility.*—Slightly in water; miscible with Alcohol, Chloroform, Ether, Benzene, Petroleum Benzin, or fixed and volatile oils.

IMPURITIES.—Bromides and brominated compounds, free bromine, free acid.

INCOMPATIBLES.—Caustic alkalies; water.

Dose, 0.2 mil (3 ♏).

For the Therapeutics of Bromoform, *see* p. 782.

IX. IODOFORMUM

IODOFORM.—Abv.—Iodof. $CHI_3 = 393.77$. *Synonym.*—Triiodomethane. Usually obtained by the action of Iodine upon Alcohol, or Acetone in the presence of an alkali or alkaline carbonate.

SOURCE.—Heat together Alcohol, Iodine, Potassium Bicarbonate, and water. $C_2H_6O + 8I + 2KHCO_3 = 2CHI_3 + 2KI + 3H_2O + 2CO_2$.

CHARACTERS.—A fine, lemon-yellow powder, or lustrous crystals of the hexagonal system, having a peculiar, very penetrating and persistent odor, and an unpleasant, slightly sweetish taste suggestive of Iodine. *Solubility.*—Nearly insoluble in water, to which, however, it imparts its odor and taste; in 60 parts of Alcohol and 16 of boiling Alcohol; in 75 parts of Ether; in 10 parts of Chloroform, or in fixed and volatile oils. It contains 96.7 per cent. of Iodine.

IMPURITIES.—Soluble iodides, free acids, soluble yellow coloring matters, picric acid, etc.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Unguentum Iodoformi.—Iodoform Ointment. Abv.—Ung. Iodof.
Iodoform, 10; Benzoinated Lard, 90.

For the Therapeutics of Iodoform *see* p. 314.

X. ÆTHYLIS CHLORIDUM

ETHYL CHLORIDE. Abv.—Æthyl. Chlor. Monochlorethane, C_2H_5Cl or $CH_3CH_2Cl = 64.50$. *Synonym.*—Hydrochloric Ether. When liberated from its container it vaporizes at once; *the gas is very inflammable, and it must not be used in proximity to fire.*

SOURCE.—By the action of Hydrochloric Acid gas upon Dehydrated Ethyl Alcohol.

CHARACTERS.—A colorless, mobile, very volatile liquid, having a characteristic, ethereal odor, and a burning taste. It boils at a temperature between 12° to 13°C. (53.6°F. to 55°F.). Sp. gr., about 0.921 at 0°C. (32°F.). *Solubility.*—Slightly in water; freely in Alcohol and in Ether.

IMPURITIES.—Alcohol, hydrochloric acid, sulphur compounds.

For the Therapeutics of Ethyl Chloride *see* p. 694.

XI. ACETONUM

ACETONE. Abv.—Aceton. *Synonym.*—Dimethylketone. A liquid containing not less than 99 per cent. by weight, of absolute Acetone, C_3H_6O or $CH_3 CO \cdot CH_3 = 58.05$.

SOURCE.—It is contained in considerable quantities in the product obtained in the distillation of wood, and can be separated from the mixture after the removal of the Acetic Acid. It may be purified by agitating a mixture containing it with a concentrated solution of Mono-Sodium Sulphite. It unites with the salt, forming a compound anologous to that formed with Aldehyde. The double compound can be separated, and, when distilled with the addition of Potassium Carbonate, Acetone passes over.

CHARACTERS.—A transparent, colorless, mobile and volatile liquid of a characteristic ethereal odor and a pungent, sweetish taste. Sp. gr., about 0.790. *Solubility.*—Miscible with water in all proportions, without cloudiness; also miscible with Alcohol, Ether, Chloroform and most volatile oils.

IMPURITIES.—Empyreumatic substances.

For the Uses of Acetone *see* p. 829.

XII. METHYLTHIONINÆ CHLORIDUM

METHYLTHIONINE CHLORIDE. Abv.—Methylthionin. Chlor. *Synonyms.*—Methylene Blue. Tetramethylthionine Chloride. $C_{16}H_{18}N_3ClS$ = 373.75.

SOURCE.—Tetramethylthionine Chloride results from the action of Hydrogen Sulphide upon the oxidation product of Para-amido-dimethyl-aniline.

CHARACTERS.—A dark green, crystalline powder, or in prismatic crystals having a lustre resembling bronze. *Solubility.*—Freely in water and Alcohol; soluble in Chloroform; the solutions having a deep blue color.

IMPURITIES.—Arsenic, zinc and other mineral impurities; dextrin and commercial dyes.

Dose, 0.150 gm. = 150 milligm. (2½ gr.).

For the Therapeutics of Methylthionine Chloride *see* p. 335.

2. THE SULPHUR DERIVATIVES

Sulphonmethane, Sulphonethylmethane

I. SULPHONMETHANUM

SULPHONMETHANE. Abv.—Sulphonmeth. Diethylsulphonedimethylmethane, $C_7H_{16}S_2O_4$ or $(CH_3)_2C(SO_2C_2H_5)_2$ = 228.27. *Synonym.*—Sulphonal.

SOURCE.—Mercaptan (Ethyl Hydrosulphide) is combined with Acetone to form Mercaptol, which by oxidation with Potassium Permanganate yields Sulphonmethane.

CHARACTERS.—Colorless, inodorous, and nearly tasteless prismatic crystals, or as a crystalline powder. *Solubility* —In 365 parts of water and 16 of boiling water; in 60 parts of Alcohol and 3 of boiling Alcohol; 64 parts of Ether and in 11 of Chloroform; soluble in Benzene.

IMPURITIES.—Sulphates, chlorides, readily oxidizable organic impurities.

Dose, 0.750 gm. = 750 milligm. (12 gr.).

For the Therapeutics of Sulphonmethane *see* p. 767.

II. SULPHONETHYLMETHANUM

SULPHONETHYLMETHANE. Abv.—Sulphonethylmeth. Diethylsulphonmethylethylmethane, $C_8H_{18}S_2O_4$ or $(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$ = 242.38. *Synonym.*—Trional.

SOURCE.—By the oxidation of the Mercaptol obtained by the condensation of Methylethylketone with Ethylmercaptan. It contains three Ethyl groups, instead of two, as does Sulphonal.

CHARACTERS.—Colorless, lustrous, odorless, crystalline scales, which have a bitter taste in aqueous solution. *Solubility.*—In 200 parts of water; more soluble in boiling water; soluble in Alcohol and Ether.

IMPURITIES.—The same as those of Sulphonmethane.

Dose, 0.750 gm. = 750 milligm. (12 gr.).

For the Therapeutics of Sulphonethylmethane *see* p. 768.

3. THE UREA DERIVATIVES

Ethyl Carbamate

ÆTHYLIS CARBAMAS

ETHYL CARBAMATE. Abv.—Æthyl. Carbam. The ethyl ester of Carbamic Acid, $C_3H_7O_2N$ or $CO(OC_2H_5)NH_2 = 89.07$. *Synonym.*—Urethane.

SOURCE.—By the reaction of Ethyl Alcohol upon Urea (Carbamide) or one of its salts.

CHARACTERS.—Colorless, columnar crystals or scales; odorless, and having a cooling, saline taste. *Solubility.*—In 0.45 part of water; 0.8 part of Alcohol, 1.5 parts of Ether; 0.9 part of Chloroform; 2.5 parts of Glycerin; in 32 parts of Olive Oil.

IMPURITY.—Urea or carbamide, chlorides, nitrates.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Ethyl Carbamate *see* p. 770.

GROUP IV

The Ethers

Ether, Spirit of Nitrous Ether, Amyl Nitrite, Spirit of Glyceryl Trinitrate, Sodium Nitrite.

I. ÆTHER

ETHER. *Synonyms.*—Ethylic Ether. Ethyl Oxide. A liquid containing not less than 95.5 per cent. nor more than 97.5 per cent. of Ethyl Oxide, $(C_2H_5)O = 74.08$, the remainder consisting of Alcohol containing a little water. When used for anæsthesia it is to be dispensed only in small, well-closed containers, and is not to be used for this purpose if the container has been opened longer than twenty-four hours.

SOURCE.—Alcohol is distilled with Sulphuric Acid. Ethyl Sulphuric (Sulphovinic) Acid and water are first formed. $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + H_2O$; then $C_2H_5HSO_4 + C_2H_5OH = (C_2H_5)_2O + H_2SO_4$. This process is theoretically continuous, the Sulphuric Acid last formed again acting on fresh Alcohol as it is supplied. The Ether is freed from water by re-distillation with Calcium Chloride and Lime.

CHARACTERS.—A transparent, colorless, mobile liquid, having a characteristic odor, and a burning and sweetish taste. It boils at about 35°C. (95°F.). Sp. gr., 0.713 to 0.716. *Solubility.*—In about 12 volumes of water; miscible, in all proportions, with Alcohol, Chloroform, Petroleum Benzin, and fixed or volatile oils.

IMPURITIES.—Water, alcohol, aldehyde.

Dose, 1 mil (15 ♏).

Ether is used to make Collodium.

Preparation

Spiritus Ætheris.—Spirit of Ether. Abv.—Sp. Æth. *Synonym.*—Hoffman's Drops. Ether, 325; Alcohol, to 1000.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Ether *see* p. 783.

II. SPIRITUS ÆTHERIS NITROSI

SPIRIT OF NITROUS ETHER. Abv.—Sp. Æth. Nitros. *Synonym.*—Sweet Spirit of Nitre. An alcoholic solution of Ethyl Nitrite, $C_2H_5NO_2 = 75.05$, containing not less than 3.5 per cent. nor more than 4.5 per cent. of Ethyl Nitrite. In many commercial specimens there is very little Ethyl Nitrite.

SOURCE.—Mix Sulphuric Acid, 40, with water, 120, cool, add Alcohol 85, diluted with an equal volume of water, and pour the solution into a flask surrounded by a mixture of ice and water. Dissolve Sodium Nitrite, 100, in water, 280 filter, and allow the liquid to drop slowly into the flask containing the acid mixture. When the reaction is complete, allow any crystals which may have formed to settle, and decant the cold mixture of Ethyl Nitrite and aqueous solution, drawing off and discarding the aqueous liquid. Wash the separated Ethyl Nitrite with ice-cold water, 20, remove traces of acid by Monohydrated Sodium Carbonate, 0.6, dissolved in water; agitate with Potassium Carbonate 3, to remove all traces of water, and add Alcohol, 500. Add enough Alcohol to make the mixture weigh twenty-two times the amount of Ethyl Nitrate added.

CHARACTERS.—A clear, mobile, volatile, inflammable liquid of a pale yellowish or faintly greenish-yellow tint, having a fragrant, ethereal and pungent odor, free from acridity, and a sharp, burning taste. Sp. gr., not above 0.823 at 25°C. (77°F.).

IMPURITY.—Aldehyde.

INCOMPATIBLES.—Acetanilid, acetphenetidin, antipyrine, carbonates, fluid-extract of buchu, ferrous sulphate, iodides, tincture of guaiac, gallic and tannic acids, emulsions.

Dose, 2 mil (30 ♏).

Spirit of Nitrous Ether is contained in Mistura Glycyrrhizæ Composita.

For the Therapeutics of Spirit of Nitrous Ether *see* p. 505.

III. AMYLIS NITRIS

AMYL NITRATE. Abv.—Amyl. Nitris. A liquid containing not less than 80 per cent. of Amyl (principally Iso-Amyl) Nitrite, $C_5H_{11}NO_2 = 117.11$. It is dispensed in small glass ampoules which can be readily broken when required.

SOURCE.—By action of Sodium Nitrite and Diluted Sulphuric Acid upon Amylic Alcohol. $2NaNO_2+H_2SO_4+2C_5H_{11}OH=2C_5H_{11}NO_2+Na_2SO_4+2H_2O$. Purify the distillate with Sodium Carbonate.

CHARACTERS.—A clear, yellowish liquid, of a peculiar, ethereal, fruity odor, and a pungent, aromatic taste; inflammable and very volatile. Sp. gr., 0.865 to 0.875 at 25°C. (77°F.). *Solubility.*—Almost insoluble in water; miscible with Alcohol or Ether.

IMPURITIES.—Free acid, water, aldehyde.

Dose, by inhalation, 0.2 mil (3 ♏).

For the Therapeutics of Amyl Nitrite *see* p. 496.

IV. SPIRITUS GLYCERYLIS NITRATIS

SPIRIT OF GLYCERYL TRINITRATE. Abv.—Sp. Glyceryl. Nit. *Synonyms.*—Spirit of Nitroglycerin. Spirit of Glonoin. An alcoholic solution containing not less than 1 per cent., or more than 1.1 per cent. of Glyceryl Trinitrate, $C_3H_5(NO_3)_3=227.07$. Great care should be exercised in dispensing, handling, packing transporting and storing it, since a dangerous explosion may result if any considerable quantity of it be spilled, and the Alcohol be partly or wholly lost by evaporation. It it be spilled, a solution of Potassium Hydroxide should at once be poured over it, to effect decomposition.

SOURCE.—Nitroglycerin is prepared by gradually adding dehydrated Glycerin to Nitric and strong Sulphuric Acid, the result being Propenyl trinitrate or Trinitroglycerin. $C_3H_5(OH)_3+3HNO_3=C_3H_5(NO_3)_3+3H_2O$. It separates as an oily layer which is washed with water and with dilute soda solution to remove all acid.

CHARACTERS.—A clear, colorless liquid, having the odor of Alcohol. ***Caution should be exercised in tasting it,*** since even a small quantity is liable to produce a violent headache. The same effect is produced when it is freely applied to the skin. Sp. gr., 0.814 to 0.820.

Dose, 0.05 mil (1 ♏).

For the Therapeutics of Glyceryl Trinitrate *see* p. 502.

V. SODII NITRIS

SODIUM NITRITE. Abv.—Sod. Nitris. It contains not less than 95 per cent. of Sodium Nitrite, $NaNO_2=69.01$.

SOURCE.—Made by heating Sodium Nitrate with Lead, which becomes an oxide, taking oxygen from the Sodium Nitrate. $NaNO_3+Pb=NaNO_2+PbO$.

CHARACTERS.—White, or nearly white, opaque, fused masses, or sticks, or colorless, transparent, hexagonal crystals, or as a granular powder; odorless, and having a mild, saline taste. When exposed to the air, the salt deliquesces and is gradually oxidized to Sodium Nitrate and becomes unfit for use. *Solubility.*—In 1.5 parts of water; very soluble in boiling water; sparingly soluble in Alcohol.

IMPURITIES.—Heavy metals.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Sodium Nitrite *see* p. 504.

GROUP V

The Phenols and Phenol Derivatives

Phenol, Liquefied Phenol, Sodium Phenosulphonate, Zinc Phenolsulphonate, Phenolphthalein, Phenylcinchoninic Acid, Cresol, Trinitrophenol, Thymol Iodide, Resorcinol

I. PHENOL

PHENOL. $C_6H_5OH = 94.05$. *Synonyms.*—Carbolic Acid. Phenyl Alcohol. It contains not less than 97 per cent. of Phenol.

SOURCE.—Hydroxybenzene, obtained either from Coal Tar by fractional distillation and subsequent purification, or made synthetically.

CHARACTERS.—Colorless, interlaced or separate needle-shaped crystals, or a white crystalline mass, sometimes acquiring a red tint; having a characteristic, somewhat aromatic odor, and, when copiously diluted with water, a sweetish taste, with a slightly burning after-taste. When undiluted it cauterizes and whitens the skin and mucous membrane. Pure Phenol does not absorb moisture from the atmosphere, but usually it retains a minute quantity of water, by which it becomes deliquescent. With a little more water, it forms an oily liquid, which crystallizes at a lower temperature. Phenol is liquefied by the addition of about 5 per cent. of water. When gently heated, it melts, forming a highly refractive liquid. It has a faintly acid reaction. *Solubility.*—In 5 parts of water, the solubility varying according to the degree of hydration of the Phenol; very soluble in Alcohol, Ether, Chloroform, Benzene, Carbon Disulphide, Glycerin, or in fixed or volatile oils. Solution in water is easily made if an equal part of Glycerin is added.

IMPURITIES.—Creosote, cresol.

INCOMPATIBLES.—Albumin, acetanilid, acetphenetidin, antipyrine, camphor, collodion, ethyl carbamate, ferric salts, hydrogen dioxide, hydrated chloral, lead acetate, menthol, nitric acid, phenyl salicylate, potassium permanganate, pyrogallol, resorcinol, sodium phosphate, terpin hydrate, thymol.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

II. PHENOL LIQUEFACTUM

LIQUEFIED PHENOL. Abv.—Phenol Liq. A liquid composed of not less than 87 per cent. of Phenol.

SOURCE.—Liquefy Phenol, by placing the unstoppered container in a water-bath, and apply heat gradually until the crystals have melted; transfer the liquid to a tared vessel and weigh it; then add for each 9 parts, by weight, of Phenol, 1 part, by weight, of Distilled Water, and mix thoroughly.

CHARACTERS.—A colorless liquid, which may develop a slight reddish tint upon keeping, having a characteristic, somewhat aromatic odor. Sp. gr., about 1.065. *Solubility.*—Miscible, in all proportions, with Alcohol, Ether or Glycerin. When it is diluted with an equal volume of Glycerin, the mixture is miscible with water.

Dose, 0.05 mil (1 m).

Preparation

1. **Unguentum Phenolis.**—Ointment of Phenol. Abv.—Ung. Phenol. Liquefied Phenol, 2.25; Ointment, 97.75.

2. **Glyceritum Phenolis.**—Glycerite of Phenol. Abv.—Glycer. Phenol. Liquefied Phenol, 20; Glycerin, 80.

Dose, 0.3 mil (5 ♏).

For the Therapeutics of Phenol *see* p. 304.

III. SODII PHENOLSULPHONAS

SODIUM PHENOLSULPHONATE. Abv.—Sod. Phenolsulph. $NaC_6H_5O\text{-}SO_3+2H_2O=232.14$. *Synonyms.*—Sodium Paraphenolsulphonate. Sodium Sulphocarbolate. It contains not less than 83.64 per cent. nor more than 87.82 per cent. of anhydrous Sodium Phenolsulphonate corresponding to not less than 99 per cent. of the crystallized salt.

SOURCE.—Phenolsulphuric Acid is formed by adding Sulphuric Acid to crystallized Phenol; on heating this mixture it becomes Paraphenolsulphuric Acid, which yields a clear solution with water. $C_6H_5OH+H_2SO_4=C_6H_5HSO_4+H_2O$. Barium Carbonate is then added, and Barium Phenolsulphonate is precipitated. $2C_6H_5HSO_4+BaCO_3=Ba(SO_3C_6H_4(OH))_2+H_2O+CO_2$. This is treated with water and Sodium Carbonate; a solution of Sodium Phenolsulphonate is formed and Barium Carbonate is precipitated. $Ba(SO_3C_6H_4(OH))_2+Na_2CO_3=2Na\text{-}C_6H_4(OH)SO_3+BaCO_3$. The solution is evaporated to crystallization.

CHARACTERS.—Colorless, transparent, rhombic prisms or crystalline granules; odorless, and having a cooling, saline, bitter taste. It is somewhat efflorescent in dry air. *Solubility.*—In 4.2 parts of water and in 0.8 part of boiling water; in about 5 parts of Glycerin; in 140 parts of Alcohol and 13.5 of boiling Alcohol.

IMPURITIES.—Heavy metals.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

IV. ZINCI PHENOLSULPHONAS

ZINC PHENOLSULPHONATE. Abv.—Zinc. Phenolsulph. $(C_6H_5O\cdot SO_3)_2\text{-}Zn+8H_2O=555.72$. *Synonyms.*—Zinc Paraphenolsulphonate. Zinc Sulphocarbolate. It contains not less than 73.7 per cent. nor more than 77.4 per cent. of anhydrous Zinc Phenolsulphonate, corresponding to not less than 99.5 per cent. of the crystallized salt.

SOURCE.—Phenolsulphuric Acid is formed by adding Sulphuric Acid to Phenol. This is treated with Zinc Oxide; the Zinc Phenolsulphonate crystallizes out on evaporation.

CHARACTERS.—Colorless, transparent, rhombic prisms or tabular crystals, or in granular form; odorless, and having an astringent, metallic taste. Exposed to the air the salt effloresces, and upon exposure to light and air may become slightly pink. *Solubility.*—In 1.6 parts of water or Alcohol and in 0.4 part of boiling water, and in 1.8 parts of Alcohol.

IMPURITIES.—The sulphate and chloride, arsenic, cadmium, lead, copper.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

For the Therapeutics of the Phenolsulphonates *see* p. 312.

V. PHENOLPHTHALEINUM

PHENOLPHTHALEIN. Abv.—Phenolphthal. A dibasic phenol derivative (Dihydroxyphthalophenone) $C_{20}H_{14}O_4$ or $(C_6H_4OH)_2CO{\cdot}C_6H_4CO = 318.11$.

SOURCE.—By heating Phenol, 10; with Phthalic Anhydride, 5; and Sulphuric Acid, 4; to 120°C. (248°F.) for about ten hours, exhausting the product with boiling water, dissolving the residue in dilute solution of Sodium Hydroxide, and precipitating with Acetic Acid. It is purified by boiling its Alcoholic solution with animal charcoal and precipitating with water, and crystallization.

CHARACTERS.—A white or faintly yellowish-white, crystalline powder; odorless and tasteless; permanent in the air. *Solubility.*—It dissolves in 13 parts of Alcohol, and in about 71 parts of Ether at 25°C. (77°F.); almost insoluble in water.

IMPURITIES.—Fluorane, heavy metals.

Dose, 0.15 gm. = 150 milligm. (2½ gr.).

For the Therapeutics of Phenolphthalein *see* p. 661.

VI. ACIDUM PHENYLCINCHONINICUM

PHENYLCINCHONINIC ACID. Abv.—Acid. Phenylcinch. *Synonym.*—Phenyl-quinoline-carboxylic Acid. An organic acid, 2-phenyl-quinoline-4-carboxylic acid, $C_{16}H_{11}O_2N$ or $C_6H_5{\cdot}C_9H_6N{\cdot}COOH = 249.10$.

SOURCE.—By warming Pyroracemic Acid, Benzaldehyde and Aniline in an Alcoholic solution, filtration and purification.

CHARACTERS.—Small, colorless needles or a white or yellowish-white microcrystalline powder; odorless or having a slight odor resembling Benzoic Acid, and a bitter taste. It is permanent in the air. *Solubility.*—Insoluble in cold water; slightly soluble in cold Alcohol, hot water or Ether; readily soluble in hot Alcohol.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Phenylcinchoninic Acid *see* p. 571.

VII. CRESOL

CRESOL. C_7H_8O or $C_6H_4{\cdot}CH_3{\cdot}OH = 108.06$.

SOURCE.—A mixture of the isomeric Cresols obtained from coal tar, freed from Phenol, hydrocarbons and water.

CHARACTERS.—A colorless or yellowish to brown-yellow, highly refractive liquid, having a phenol-like, sometimes empyreumatic, odor and becoming darker, or assuming a reddish tint with age and on exposure to light. Sp. gr. 1.030 to 1.038. *Solubility.*—In about 50 parts of water usually forming a cloudy solution; miscible in all proportions, with Alcohol, Ether, Glycerin, Benzene and Petroleum Benzin; it is dissolved by solutions of fixed alkali hydroxides.

IMPURITIES.—Phenol, hydrocarbons.

Dose, 0.05 mil (1 ♏).

Preparation

Liquor Cresolis Compositus.—Compound Solution of Cresol. Abv.—Liq. Cresol. Co. Cresol, 500; Linseed Oil, 350; Potassium Hydroxide, 80; Alcohol, 30; Water to 1000. Potassium Hydroxide, 80; in this process may be replaced by Sodium Hydroxide, 54.

For the Therapeutics of Cresol *see* p. 310.

VIII. TRINITROPHENOL

TRINITROPHENOL. Abv.—Trinitrophen. *Synonym.*—Picric Acid. $C_6H_3O_7N_3$ or $C_6H_2(OH)(NO_2)_3$ 1 : 2 : 4 : 6 = 229.05. For safety in transportation it is usually mixed with 20 per cent. of water.

SOURCE.—By adding 1 part of phenol to 3 parts of warm nitric acid, and after the reaction has ceased, add 3 parts of fuming nitric acid, heating and finally evaporating; on cooling the new compound will crystallize out. It is purified by recrystallization, after washing with cold water, from boiling water or diluted alcohol.

CHARACTERS.—Pale yellow, rhombic prisms or scales; odorless, and having an intensely bitter taste. It explodes when heated rapidly and when exposed to percussion. *Solubility.*—In 78 parts of water; 12 parts of Alcohol; 35 parts of Ether and in 10 parts of Benzene at 25°C. (77°F.); also in 15 parts of boiling water.

IMPURITIES.—Sulphates.

Dose, 0.03 gm. = .30 milligm. (½ gr.).

For the Therapeutics or Trinitrophenol *see* p. 313.

IX. THYMOLIS IODIDUM

THYMOL IODIDE. Abv.—Thymol Iod. $C_{20}H_{24}O_2I_2$ or $(C_6H_2{\cdot}CH_3{\cdot}C_3H_7{\cdot}OI)_2$ = 550.03. *Synonyms.*—Dithymol-diiodide Aristol. It contains, when dried to constant weight, not less than 43 per cent. of Iodine.

SOURCE.—It is prepared by the decomposition of a solution of Iodine in Potassium Iodide by Thymol dissolved in a solution of Sodium Hydroxide. The precipitate is washed with water and dried.

CHARACTERS.—A reddish-brown or reddish-yellow, bulky powder, with a very slight aromatic odor. *Solubility.*—Insoluble in water or Glycerin; readily soluble in Ether, Chloroform, Collodion or in fixed or volatile oils; slightly soluble in Alcohol.

IMPURITIES.—Iodides, free iodine, sodium carbonate, inorganic impurities.

For the Therapeutics of Thymol Iodide *see* p. 335.

X. RESORCINOL

RESORCINOL. Abv.—Resorcin. $C_6H_4(OH)_2$ = 110.05. It contains not less than 99.5 per cent. of Resorcinol.

SOURCE.—Metadihydroxybenzene, which is Resorcinol, $C_6H_4(OH)_2$, is usually obtained by the reaction of fused Sodium Hydroxide upon Sodium Metabenzenedisulphonate.

CHARACTERS.—Colorless, or nearly colorless, needle-shaped crystals, or a powder having a faint, peculiar odor, and a sweetish followed by a bitter taste. It acquires a pink tint on exposure to light and air. *Solubility.*—In 0.9 part of water; in 0.9 part of Alcohol; freely soluble in Ether or Glycerin; slightly soluble in Chloroform.

IMPURITIES.—Phenol, quinol, catechol, empyreumatic bodies.

INCOMPATIBLES.—Acetanilid, alkalies, antipyrine, camphor, ferric chloride, menthol, spirit of nitrous ether, ethyl carbamide.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

For the Therapeutics of Resorcinol *see* p. 671.

GROUP VI

The Naphthols

Betanaphthol, Bismuth Betanaphthol

I. BETANAPHTHOL

BETANAPHTHOL. Abv.—Betanaph. $C_{10}H_7OH = 144.06$. *Synonym.*—Naphthol. A monohydroxyphenol of Naphthalene.

SOURCE.—Concentrated Sulphuric Acid is allowed to act on Naphthalene, whereby Betanaphthalenesulphonic Acid is formed ($C_{10}H_7HSO_3$). This acid is dissolved in water, saturated with Milk of Lime, and the resulting Calcium Salt separated by crystallization. The crystals are re-dissolved in water and decomposed by Sodium Carbonate, yielding Sodium Naphthalenesulphonate ($C_{10}H_7SO_3Na$). The Sodium Salt is next added to fused Sodium Hydroxide, Sodium-naphthol, $C_{10}H_7ONa$, and Sodium Sulphite, $NaSO_3$, is formed. The former is treated with Hydrochloric Acid, yielding Betanaphthol and Sodium Chloride, and the Betanaphthol is purified by sublimation and re-crystallization from hot water.

CHARACTERS.—Colorless, or pale buff-colored, shining, crystalline laminæ, or a white or yellowish-white crystalline powder, having a faint phenol-like odor and a pungent taste. *Solubility.*—In about 1000 parts of water and in 80 parts of boiling water; in 0.8 part of Alcohol; in 1.3 parts of Ether; in 17 parts of Chloroform; soluble in Glycerin and Olive Oil and easily dissolved by alkali hydroxide solutions.

IMPURITIES.—Alphanaphthol, naphthalene and other organic substances.

INCOMPATIBLES.—Antipyrine, camphor, ferric chloride, menthol, phenol, potassium permanganate, ethyl carbamate.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

II. BISMUTHI BETANAPHTHOLAS

BISMUTH BETANAPHTHOL. Abv.—Bism. Betanaph. A compound of Bismuth and Betanaphthol of somewhat varying composition, yielding not less than 15 per cent. of Betanaphthol ($C_{10}H_7OH = 144.06$) and, upon ignition, not less than 73 per cent., nor more than 78 per cent. of Bismuth Oxide ($iB_2O_3 = 464.00$).

SOURCE—By the action of Betanaphthol in an alkaline solution upon Bismuth Trinitrate dissolved in dilute Glycerin or in an acid solution which precipitates the Bismuth Betanaphthol.

CHARACTERS.—A buff-colored to grayish-brown, amorphous powder; odorless or having a faint odor of Betanaphthol; tasteless; permanent in the air. *Solubility.*—Nearly insoluble in water, Alcohol, Chloroform or Ether; partially dissolved by mineral acids with the formation of the corresponding Bismuth Salts and the liberation of Betanaphthol.

IMPURITIES.—Free betanaphthol, nitrates, sulphates, lead, copper, silver.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Betanaphthol and Bismuth Betanaphthol *see* p. 671.

GROUP VII

The Nitrogen-Benzene Derivatives

Acetanilid, Acetphenetidin, Benzosulphinide, Sodium Benzosulphinide

I. ACETANILIDUM

ACETANILID. Abv.—Acetanil. $C_8H_9ON = 135.08$. *Synonyms.*—Phenylacetamide. Antifebrin. The monacetyl derivative, $(C_6H_5NH{\cdot}CH_3{\cdot}CO)$, of Aniline.

SOURCE.—Glacial Acetic Acid and pure Aniline are heated together, the excess of both ingredients is then distilled off, and the congealed residue is crude Acetanilid, which is purified by repeated crystallization from water. $HC_2H_3O_2 + C_6H_5NH_2 = C_6H_5NH(C_2H_3O) + H_2O$.

CHARACTERS.—Colorless, shining, micaceous, crystalline laminæ, or a crystalline powder; odorless, having a faintly burning taste, and permanent in the air. *Solubility.*—In 190 parts of water and 20 of boiling water; in 3.4 parts of Alcohol and in 0.6 part of boiling Alcohol; in 17 parts of Ether; 3.7 parts of Chloroform; in 47 parts of Benzene.

IMPURITIES.—Aniline salts and allied substances.

INCOMPATIBLES.—Alkaline bromides and iodides, chloroform, hydrated chloral, phenol, potassium and sodium hydroxides, resorcinol, spirit of nitrous ether, thymol.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

For the Therapeutics of Acetanilid *see* p. 584.

II. ACETPHENETIDINUM

ACETPHENETIDIN. Abv.—Acetphen. $C_{10}H_{13}O_2N = 179.11$. *Synonyms.*—Para-acetphenetidin. Phenacetin. The monacetyl derivative, Acetparaphenetidin, $C_6H_4(OC_2H_5){\cdot}NH{\cdot}CH_3CO$ 1 : 4, the product of the acetylization of Para-amidophenetol.

SOURCE.—By action of Glacial Acetic Acid upon Paraphenetidin, a product of Paranitrophenol, $C_6H_5OC_2H_5NH_2 + HC_2H_3O_2 = C_6H_4OC_2H_5NHC_2H_3O + H_2O$.

CHARACTERS.—White, glistening, crystalline scales, or a fine crystalline powder; odorless, having a slightly bitter taste and producing a faint benumbing effect on the tongue; permanent in the air. *Solubility.*—In 1310 parts of water and 82 of boiling water; in 15 parts of Alcohol and 28 of boiling Alcohol; in 90 parts of Ether and 14 parts of Chloroform.

IMPURITIES.—Paraphenetidin, acetanilid.

INCOMPATIBLES.—Hydrated chloral, iodine, phenol, salicylic acid, and various oxidizers.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

For the Therapeutics of Acetphenetidin *see* p. 589.

III. BENZOSHINULPIDUM

BENZOSULPHINIDE. Abv.—Benzosulphinid. $C_7H_5O_3NS$ or $C_6H_4SO_2{\cdot}CONIH = 183.12$. The anhydride of Orthosulphamide-benzoic Acid (Benzoylsulphonicimide). *Synonyms.*—Glusidum. Saccharin. Orthosulphamide-Benzoic Anhydride. Glucusimide.

SOURCE.—It is derived from Toluene, $C_6H_5CH_3$, a derivative of coal tar. The toluene is treated with concentrated Sulphuric Acid at 100°C. (212°F.) by which means there are formed Ortho- and Para-sulphonic Acids, which are first converted into Calcium salts, and then, by the use of Sodium Carbonate, into Sodium salts. From these a mixture of Ortho- and Para-toluenesulphochlorides is obtained by the action of Phosphorus Pentachloride; upon thoroughly cooling the mixture the para-modification crystallizes out, and is thus separated. From the other isomeric chloride, Orthotoluene-sulphamide is formed by means of dry Ammonia gas. This sulphamide is next oxidized with Potassium Permanganate, converting it into Potassium Orthosulphamine-benzoate, the solution of which is freed from precipitated Manganese Dioxide and decomposed by means of an acid; instead of separating as free Orthosulphamide-benzoic Acid, the latter splits up into its anhydride, which is known as Saccharin, and water.

CHARACTERS.—As white crystals or a white crystalline powder, odorless or having a faint aromatic ador and having an intensely sweet taste even in dilute solutions (1 of Saccharin, in sweetening power, being equal to 300 of Cane Sugar). *Solubility.*—In 290 parts of water and 25 of boiling water; in 31 parts of Alcohol; slightly soluble in Ether or Chloroform; easily dissolved by Ammonia Water, or alkali hydroxide solutions, also by a solution of Sodium Bicarbonate with the evolution of Carbon Dioxide.

IMPURITIES.—Glucose, milk-sugar, benzoic and salicylic acids, carbohydrates, inorganic impurities. Commercial Saccharin is not a pure or uniform product; it often contains less than 50 per cent. of actual Saccharin.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

IV. SODII BENZOSULPHINIDUM

SODIUM BENZOSULPHINIDE. Abv.—Sod. Benzosulphin. *Synonyms.*—Sodium-Saccharin. Soluble Saccharin. The Sodium Salt, $(NaC_7H_4O_3NS + 2H_2O = 241.14)$, of Benzosulphinide.

SOURCE.—By neutralizing an aqueous solution of Benzosulphinide with Sodium Carbonate or Bicarbonate and slowly crystallizing the solution.

CHARACTERS.—Colorless, rhombic prisms or a white, crystalline powder; odorless or having a faintly aromatic odor and an intensely sweet taste, even in dilute solutions; somewhat efflorescent. *Solubility.*—In 1.2 parts of water, and in about 50 parts of alcohol.

IMPURITIES.—The same as for Benzosulphinide with the addition of benzoates and salicylates.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

For the Therapeutics of Benzosulphinide and Sodium Benzosulphinide *see* p. 581.

GROUP VIII

The Organic Bases

Antipyrine, Betaeucaine Hydrochloride

I. ANTIPYRINA

ANTIPYRINE. Abv.—Antipyr. *Synonym*—Phenazone. Phenyldimethyl pyrazolone. $C_{11}H_{12}ON_2$ or $C_3HON_2(CH_3)_2 \cdot C_6H_5 = 188.12$.

SOURCE.—Aceto-acetic Ether is acted upon by Phenylhydrazine, when Phenyl-monomethylpyrazolone, Ethyl Alcohol, and water are formed. $CH_3CO \cdot CH_2 \cdot O \cdot OC_2H_5 + C_6H_5HN \cdot NH_2 = C_6H_5N(CH_3)C_3H_2N_2O + C_2H_5OH + H_2O$. The Monomethyl compound is dissolved in Methyl Alcohol and treated with Methyl Iodide. $C_6H_5(CH_3)C_3H_2N_2O + CH_3I = C_3HON_2(CH_3)_2C_6H_5 + HI$.

CHARACTERS.—A white, almost odorless, crystalline powder, or tabular crystals, with a slightly bitter taste. *Solubility.*—In less than 1 part of water; in 1.3 of Alcohol; 1 of Chloroform; and in 43 parts of Ether.

IMPURITIES.—Acetanilid, acetphenetidin.

INCOMPATIBLES.—Iron sulphate, iodide, and chloride, copper sulphate, alum, ammonia water, amyl nitrite, benzoates, lead subacetate, resorcinol, sodium bicarbonate, thymol, ethyl carbamate, iodine, arsenic iodide, phenol, hydrocyanic and nitric acids, potassium permanganate, salicylates, calomel, mercuric chloride, spirit of nitrous ether; all preparations of tannic acid give a white precipitate; chloral decomposes it unless in dilute solution.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

For the Therapeutics of Antipyrine *see* p. 588.

II. BETAEUCAINÆ HYDROCHLORIDIUM

BETAEUCAINE HYDROCHLORIDE. Abv.—Betaeucain. Hydrochlor. *Synonym.*—Eucaine. A synthetic derivative of Piperidene, containing when dried to constant weight, not less than 99 per cent. of the Hydrochloride of 2, 6, 6-trimethyl- 4 benzoyl-oxy-piperidine ($C_{15}H_{21}O_2NHCl$ or $C_5H_7N(CH_3)_2O(C_6H_5CO)HCl = 283.65$.

SOURCE.—Diacetonamine is treated with Paraldehyde, the resulting product reduced with metallic Sodium to Vinyldiacetonalkamine, and the latter benzoylated with Benzoyl Chloride. The free base Benzoylvinyldiacetonalkamine is dissolved and neutralized with Hydrochloric Acid and the salt crystallized out.

CHARACTERS.—A white, crystalline powder; odorless; permanent in the air. *Solubility.*—In 30 parts of water; 35 parts of alcohol; and 6 parts of chloroform at 25°C. (77°F.); more soluble in boiling water and boiling alcohol.

IMPURITIES.—Cocaine, alphaeucaine, readily carbonizable impurities.

For the Therapeutics of Betaeucaine Hydrochloride *see* p. 693.

DIVISION II: DRUGS DERIVED FROM THE VEGETABLE KINGDOM

GROUP I.—Drugs Acting Chiefly on the Nervous System

CLASS I.—DRUGS ACTING CHIEFLY ON THE CEREBRUM

A. CEREBRAL DEPRESSANTS OR SOPORIFICS

Opium, Morphine, Codeine, Hops, Lactucarium

OPIUM

OPIUM.—*Synonym.*—Poppy. The air-dried, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* Linné (Fam. *Papaveraceæ*), and yielding, in its normal, moist condition, not less than 9.5 per cent. of Anhydrous Morphine, when assayed. *Habitat.*—Western Asia; cultivated.

CHARACTERS.—In more or less rounded masses of variable size, but usually 8 to 15 cm. in diameter; externally grayish-brown, covered with fragments of poppy leaves and at times with some fruits of a species of *Rumex*, adhering from the packing; more or less plastic when fresh, becoming hard and brittle on keeping; internally, dark brown, interspersed with lighter areas, somewhat lustrous; odor characteristic, narcotic; taste bitter and characteristic.

VARIETIES.—The above is the official opium; but the following are met with in commerce, and may be used to prepare the alkaloids: (*a*) Constantinople Opium. Small lenticular masses, 120 to 240 gm. (¼ to ½ lb.) in weight, and enclosed in a poppy leaf, but without the *Rumex* seeds. Sometimes the terms Turkey and Levant Opium include this. (*b*) Egyptian Opium. Flat, more or less circular cakes, 5 to 7.5 cm. (2 or 3 in.) in diameter, reddish internally, covered with a leaf externally.

COMPOSITION.—(1) *Alkaloids.*—At least nineteen in number. Most are combined with Meconic Acid, some with Sulphuric Acid, and some are free. Some Morphine and Codeine Salts are official. These two alkaloids and Narceine and Thebaine are important.

The following are the alkaloids existing in Opium:

Morphine (2.5 to 22.8 per cent.).	Narceine (0.1 to 0.7 per cent.).
Codeine (0.2 to 0.7 per cent.).	Papaverine (1 per cent.).
Thebaine (0.15 to 1 per cent.).	Pseudomorphine (0.2 per cent.).
Narcotine (1.3 to 10 per cent.).	Deuteropine (not known in pure state).

Narcotine is more properly called Anarcotine.

Protopine, Oxynarcotine, Cryptopine, Cotarnine, Laudanine, Laudanosine, Meconidine, Rhœadine, Codamine, Gnoscopine, Lanthropine, in minute quantity. Apomorphine, Ethylmorphine and Diacetylmorphine are artificial alkaloids.

The following analysis shows how specimens may vary:

Patna Opium 3.98 per cent. of Morphine, 6.36 per cent. of Anarcotine.

Smyrna Opium 8.27 per cent. of Morphine, 1.94 per cent. of Anarcotine.

(2) *Neutral bodies.*—Meconin, Meconoiasin, (3) *Organic acids.*—Meconic Acid, Thebolactic Acid, (4) *Water, about 16 per cent.*, (5) *Mucilage, resin, pectin, glucose, fats, essential oil, caoutchouc, odorous substances, and ammonium, calcium and magnesium salts.*

IMPURITIES.—Water, stones, fruits, leaves, starch, gum, lead balls.

INCOMPATIBLES.—Ferric chloride gives a deep red color (due to Meconic Acid). Zinc, copper and arsenic salts, silver nitrate, lead acetate and subacetate, give precipitates of meconates, sulphates and coloring matters. All tannin-containing preparations precipitate codeine tannate. Fixed alkalies, their carbonates and ammonia, precipitate morphine and anarcotine. The small amount of glucose in opium may cause it to explode when made into a pill with silver nitrate.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

OPII PULVIS.—Powdered Opium. Abv.—Opii Pulv. Opium dried at a temperature not exceeding 70°C. (158°F.), and reduced to a very fine powder.

Powdered Opium, for pharmaceutical or medicinal purposes, when assayed, should yield not less than 10 per cent. nor more than 10.5 per cent. of Anhydrous Morphine. Powdered Opium of a higher percentage may be brought within these limits by admixture with Powdered Opium of a lower percentage, or with some inert diluent, in proper proportions.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

Extractum Opii.—Extract of Opium. Abv.—Ext. Opii. Extract of Opium yields not less than 19.5 per cent. nor more than 20.5 per cent. of anhydrous Morphine. One gramme of the extract represents about two grammes of Opium. Powdered Opium 100; Starch, Water, each, a sufficient quantity; by maceration, percolation and evaporation.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

2. Opium Deodoratum.—Deodorized Opium. Abv.—Opium Deod. *Synonym.*—Denarcotized Opium. Powdered Opium, 500; Purified Petroleum Benzin, a sufficient quantity. By maceration, decantation, filtra-

tion and drying. Opium Deodoratum should yield not less than 10 per cent. nor more than 10.5 per cent. of Anhydrous Morphine.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

3. **Pulvis Ipecacuanhæ et Opii.**—Powder of Ipecac and Opium. Abv.—Pulv. Ipecac. et Opii. *Synonym.*—Dover's Powder. Powdered Opium, 10; Ipecac, 10; Sugar of Milk, 80.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

4. **Tinctura Opii Camphorata.**—Camphorated Tincture of Opium. Abv.—Tr. Opii Camph. *Synonym.*—Paregoric. Powdered Opium, 4; Benzoic Acid, 4; Camphor, 4; Oil of Anise, 4; Glycerin, 40; Diluted Alcohol, 950; by maceration and filtration.

Dose, 4 mils (1 fl. dr.).

Camphorated Tincture of Opium is used in Mistura Glycyrrhizæ Composita.

OPIUM GRANULATUM.—Granulated Opium. Abv.—Opium Gran. Opium dried at a temperature not exceeding 70°C. (158°F.) and reduced to a coarse powder. It should yield not less than 10 per cent., nor more than 10.5 per cent. of Anhydrous Morphine. Granulated Opium of a higher percentage may be brought within these limits by admixture, in proper proportions, with Granulated Opium of a lower percentage, or with some inert diluent.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Tinctura Opii.**—Tincture of Opium. Abv.—Tr. Opii. *Synonym.*—Laudanum. Granulated Opium, 100, Alcohol, Water, Diluted Alcohol, each, a sufficient quantity, to make 1000. By maceration and percolation. Tincture of Opium, should contain in 100 mils not less than 0.95 nor more than 1.05 gm. of Anhydrous Morphine.

Dose, 0.5 mil (8 ♏).

2. **Tinctura Opii Deodorati.**—Tincture of Deodorized Opium. Abv.—Tr. Opii Deod. Granulated Opium, 100; Purified Petroleum Benzin, 75; Alcohol, 200; Water to 1000. By percolation, evaporation and filtration.

Dose, 0.5 mil (8 ♏).

The following in which the doses are arranged, may assist the student:

Name.	Dose
Extractum Opii	0.03 gm. (½ gr.).
Opii Pulvis Opium Opium Deodoratum Opium Granulatum	0.06 gm. (1 gr.).
Pulvis Ipecacuanhæ et Opii	0.500 gm. (8 gr.).
Tinctura Opii Tinctura Opii Deodorati	0.5 mil (8 ♏).
Tinctura Opii Camphorata	4 mils (1 fl. dr.).

MORPHINA.—Morphine. $C_{17}H_{19}O_3N+H_2O=303.18$. An alkaloid obtained from Opium.

SOURCE.—Opium is macerated with distilled water, and strained, the infusion is evaporated and filtered. To the filtrate Alcohol and Water of Ammonia are added, and the Morphine crystallizes out. To purify the crystals, they are boiled with Alcohol, the solution filtered, when hot, through Animal Charcoal, and set aside to crystallize.

CHARACTERS.—Colorless or white, shining rhombic prisms, or fine needles, or a crystalline powder, odorless, permanent in the air. It loses all of its water of crystallization at 100°C. (212°F.). *Solubility.*—In 3340 parts of water, 100 of Lime Water, 210 of Alcohol, 6250 of Ether, 1220 of Chloroform, and in 1075 of boiling water, in 98 of boiling Alcohol; insoluble in Benzene.

IMPURITIES.—Codeine, anarcotine, quinine, strychnine and various other alkaloids; acetanilid, meconic acid or meconates, ammonium salts.

INCOMPATIBLES.—Alkalies, tannic acid, potassium permanganate, borax, chlorates, ferric chloride, iodides, lead acetate and subacetate, magnesium oxide, spirit of nitrous ether, silver nitrate, mercuric chloride, gold and sodium chloride. These incompatibles are the same for the Morphine Salts.

Dose, 0.008 gm. = 8 milligm. (⅛ gr.).

MORPHINÆ HYDROCHLORIDUM.—Morphine Hydrochloride. Abv.—Morph. Hydrochlor. $C_{17}H_{19}O_3NHCl+3H_2O=375.68$.

SOURCE.—(1) Take a cold concentrated watery solution of Opium, precipitate the Meconic acid and resins with Calcium Chloride. (2) Evaporate the solution till it is solid, press to remove coloring matter, exhaust with boiling water, filter, and again evaporate and press; repeat this till the solution is nearly colorless. (3) Complete the decolorization by digesting with Charcoal. (4) Precipitate the Morphine with Ammonia and wash. (5) Dissolve in Hydrochloric Acid and crystallize out.

CHARACTERS.—White, silky, glistening needles, or cubical masses, or a white crystalline powder; odorless; permanent in the air. *Solubility.*—In 17.5 parts of water and 52 of Alcohol at 25°C. (77°F.); in 0.5 part of boiling water and 46 parts of Alcohol at 60°C. (140°F.); insoluble in Ether or Chloroform.

IMPURITIES.—Apomorphine, in addition to those of Morphine.

Dose, 0.008 gm. = 8 milligm. (⅛ gr.).

MORPHINÆ SULPHAS.—Morphine Sulphate. Abv.—Morph. Sulph. $(C_{17}H_{19}O_3N)_2H_2SO_4+5H_2O=758.49$.

SOURCE.—Morphine is dissolved in boiling distilled water; diluted Sulphuric Acid is added to neutralization, and on cooling the Sulphate appears in crystals.

CHARACTERS.—White, feathery, acicular silky crystals or in cubical masses; odorless, permanent in the air. *Solubility.*—In 15.5 parts of water and 565 of Alcohol at 25°C. (77°F.); in 0.7 part of water at 80°C. (176°F.), and 240 parts of Alcohol at 60°C. (140°F.); insoluble in Ether or Chloroform.

IMPURITIES.—The impurities are the same as those of Morphine.

Dose, 0.008 gm. = 8 milligm. (⅛ gr.).

Two solutions of Morphine Sulphate should be carefully distinguished: (1) The old U.S.P. Solution (1 to 480 of water), and (2) Magendie's (1 to 30 of water).

Magendie's Solution, as prepared in France, is made from the acetate, not official, and is somewhat weaker.

DIACETYLMORPHINA.—Diacetylmorphine. Abv.—Diacetyl Morph. $C_{21}H_{23}O_5N$ or $C_{17}H_{17}(O{\cdot}C_2H_3O)_2ON = 369.19$. *Synonym.*—Heroine. An alkaloid prepared from Morphine by acetylization. Preserve it in well-closed containers, protected from light.

SOURCE.—Formed from Morphine by substituting acetyl for its two hydroxyls.

CHARACTERS.—A white, crystalline powder, without odor. *Solubility.*—In about 1700 parts of water, in 31 parts of Alcohol, in 1.4 parts of Chloroform, and in 100 parts of Ether at 25°C. (77°F.).

IMPURITIES.—Other alkaloids, ammonium salts, and readily carbonizable organic impurities.

INCOMPATIBLES.—As of Morphine.

Dose, 0.003 gm. = 3 milligm. (1/20 gr.)

DIACETYLMORPHINÆ HYDROCHLORIDUM.—Diacetylmorphine Hydrochloride. Abv.—Diacetylmorph. Hydrochlor. $C_{21}H_{23}O_5N{\cdot}HCl + H_2O$ or $C_{17}H_{17}(O{\cdot}C_2H_3O)_2ON{\cdot}HCl + H_2O = 423.68$. *Synonym.*—Heroine Hydrochloride. The hydrochloride of the alkaloid Diacetylmorphine.

SOURCE.—By dissolving Diacetylmorphine in Hydrochloric Acid, concentrating the solution and crystallization.

CHARACTERS.—A white, crystalline powder without odor. *Solubility.*—In 2 parts of water at 25°C. (77°F.); soluble in alcohol; insoluble in Ether or Chloroform.

Dose, 0.03 gm. = 3 milligm. (1/20 gr.).

ÆTHYLMORPHINÆ HYDROCHLORIDUM.—Ethylmorphine Hydrochloride. Abv.—Æthylmorph. Hydrochlor. $C_{19}H_{23}O_3NHCl + 2H_2O$ or $C_{17}H_{17}ON(OH)(OC_2H_5).HCl + 2H_2O = 385.19$. *Synonym.*—Ethylmorphine Chloride. The hydrochloride of an alkaloid prepared from Morphine by Ethylation.

CHARACTERS.—White or yellowish, odorless, microcrystalline powder. *Solubility.*—In 8 parts of water and in 22 parts of Alcohol at 25°C. (77°F.); slightly soluble in Ether or Chloroform.

Dose, 0.015 = 15 milligm. (1/4 gr.).

CODEINA.—Codeine. Abv.—Codein. $C_{18}H_{21}O_3N + H_2O = 317.19$. *Synonym.*—Methyl Morphine. An alkaloid obtained from Opium, or prepared from Morphine by methylation.

SOURCE.—Usually obtained by evaporating the ammoniacal liquids remaining after the precipitation of Morphine by Ammonia in the preparation of the Hydrochloride, treating the residue with water, precipitation with Potassium Hydroxide, and purifying by dissolving in Ether and crystallization on spontaneous evaporation.

CHARACTERS.—Colorless, translucent, rhombic prisms, or a crystalline powder; odorless, slightly efflorescent in warm air. *Solubility.*—In 120 parts of water, 2 of Alcohol, 18 of Ether at 25°C. (78°F.); and 0.5 part of Chloroform, and in 1.2 part of Alcohol at 60°C. (140°F.).

IMPURITY.—Morphine.
Dose, 0.030 gm. =30 milligm. (½ gr.).

CODEINÆ PHOSPHAS.—Codeine Phosphate. Abv.—Codein. Phos. ($C_{18}H_{21}O_3NH_3PO_4+2H_2O=433.27$. The phosphate of the alkaloid Codeine.

SOURCE.—Usually obtained by neutralizing a hot aqueous solution of Codeine with Phosphoric Acid, and allowing it to crystallize.

CHARACTERS.—Fine, white, needle-shaped crystals, or a crystalline powder; odorless and very efflorescent. It yields not less than 67 per cent. of anhydrous Codeine. *Solubility.*—In 2.3 parts of water, 325 of Alcohol, 1875 of Ether, and 4500 parts of Chloroform at 25°C. (77°F.); in 0.5 part of water at 80°C. (176°F.), and 125 of boiling Alcohol.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

CODEINÆ SULPHAS.—Codeine Sulphate. Abv.—Codein. Sulph. $(C_{18}H_{21}O_3N)_2H_2SO_4+5H_2O=786.52$. The sulphate of the alkaloid Codeine.

SOURCE.—Usually obtained by neutralizing a hot aqueous solution of Codeine with Sulphuric Acid, and allowing to crystallize.

CHARACTERS.—Long, glistening, white, needle-shaped crystals, or rhombic prisms, or a crystalline powder; odorless, efflorescent in the air. *Solubility.*—In 30 parts of water, and 1280 of Alcohol at 25°C. (77°F.); in 6.5 parts of water at 80°C. (176°F.), and 440 of Alcohol at 60°C. (140°F.); insoluble in Chloroform and Ether.

Dose, 0.030 gm. = 30 milligm. (½ gr.).
For the Therapeutics of Opium and its Alkaloids, *see* p. 747.

The following are neither narcotic nor habit-forming but, because they are indirectly derived from Opium, are subject to the Federal Narcotic Law:

APOMORPHINÆ HYDROCHLORIDUM.—Apomorphine Hydrochloride. Abv.—Apomorph. Hydrochl. $C_{17}H_{17}O_2NHCl+½H_2O=312.62$. The hydrochloride of an alkaloid prepared from Morphine by the abstraction of one molecule of water.

SOURCE.—Obtained by heating Morphine in sealed tubes with an excess of Hydrochloric Acid. The Morphine loses one molecule of water, thus: $C_{17}H_{19}O_3N = C_{17}H_{17}O_2N+H_2O$.

CHARACTERS.—Minute, white or grayish-white glistening monoclinic prisms; odorless, and acquiring a greenish tint on exposure to light and air. *Solubility.*—In 50 parts of water, 50 of alcohol, at 25°C. (77°F.); in 17 parts of water at 80°C. (176°F.); very slightly soluble in Chloroform and Ether.

IMPURITIES.—Morphine, codeine, narceine, anarcotine.

Dose, (expectorant) **0.003 gm. = 3 milligm. (1/20 gr.);** (emetic by hypodermatic injection) **0.005 gm. =5 milligm. (1/12 gr.),** (by mouth) **0.010 gm. =10 milligm. (1/6 gr.).**
For the Therapeutics of Apomorphine Hydrochloride *see* p. 601.

COTARNINÆ HYDROCHLORIDUM.—Cotarnine Hydrochloride. Abv.—Cotarn. Hydrochlor. Quarternary oxymethyl—oxymethelene—dihydro—isoquinoline chloride ($C_{12}H_{11}O_3NCl$ or $(CH_3O)(CH_2O_2).C_9H_8N(CH_3)Cl=255.58$

obtained by hydrolyzing Anarcotine and treating the resulting Cotarnine $(CH_3O)(CH_2O_2)C_8H_5(CHO)\cdot NH(CH_3)$ with Hydrochloric Acid.

CHARACTERS.—A yellow, crystalline powder; odorless and deliquescent in moist air. *Solubility.*—Very soluble in water and alcohol, yielding yellow solutions.

Dose, 0.06 gm. = 60 milligm. (1 gr.)

For the Therapeutics of Cotarnine Hydrochloride *see* p. 801.

HUMULUS

HOPS. Abv.—Humul. The carefully dried strobiles of *Humulus Lupulus* Linné (Fam. *Moraceæ*), bearing their natural glandular trichomes and without the presence or admixture of more than 2 per cent. of stems, leaves or other foreign matter. *Habitat.*—Northern temperate zone; cultivated.

CHARACTERS.—Strobile ovoid-cylindrical, about 3 cm. long, consisting of a narrow, hairy, flexuous rachis and numerous imbricated, yellowish-green to pale brown, obliquely-ovate, membranaceous scales, the base of each with numerous yellowish-brown hairs, and frequently infolded on one side, enclosing a subglobular, light brown, very glandular achene; odor strong and characteristic, becoming disagreeable and valerian-like on aging; taste aromatic and bitter.

COMPOSITION.—The chief constituents are—(1) *Lupulin.* (2) *Lupulinic Acid*, 11 per cent., a bitter crystalline principle. (3) *Valerol*, 1 per cent., an aromatic volatile oil giving the odor. (4) Resin, 9 to 18 per cent. (5) Tannic acid, 3 to 4 per cent.

INCOMPATIBLES.—Mineral acids, metallic salts.

Dose, 2 gm. (30 gr.).

For the Therapeutics of Hops *see* p. 771.

LACTUCARIUM

LACTUCARIUM.—Abv.—Lactucar. The dried milk-juice of *Lactuca virosa* Linné (Fam. *Compositæ*). *Synonym.*—Lettuce. *Habitat.*—Southern and Central Europe.

CHARACTERS. Usually in quarter sections of hemispherical masses, or in irregular, angular pieces; externally dull reddish- or grayish-brown; fracture, tough, waxy; internally light brown or yellowish, somewhat porous; odor distinctive, opium-like; taste bitter. *Solubility.*—Partly soluble in Alcohol and in Ether.

COMPOSITION.—The chief constituents of Lactucarium are—(1) *Lactucerin or Lactucone*, $C_{16}H_{26}O$, about 50 per cent., a crystalline principle. (2) *Lactucin*, $C_{11}H_{12}O_3+H_2O$, resembling mannite. (3) Lactucic Acid.

IMPURITIES.—Starch and tannin.

Dose, 1 gm. (15 gr.).

Preparations

1. **Tinctura Lactucarii.**—Tincture of Lactucarium. Abv.—Tr. Lactucar. Lactucarium, 500; by treatment with Purified Petroleum

Benzin and drying, then macerate and percolate with water; Glycerin, 250, and Alcohol; evaporate, filter and add diluted Alcohol to 1000.

Dose, 2 mils (30 ♏).

2. **Syrupus Lactucarii.**—Syrup of Lactucarium. Abv.—Syr. Lactucar. Tincture of Lactucarium, 100; Glycerin, 200; Orange Flower Water, 50; Citric Acid, 1. Add the Orange Flower Water, in which the Citric Acid has been previously dissolved, to the Tincture of Lactucarium and Glycerin, filter, if necessary, and add Syrup to 1000.

Dose, 10 mils (2½ fl dr.).

For the Therapeutics of Lactucarium *see* p. 771.

B. CEREBRAL EXCITANTS

Belladonna, Atropine, Homatropine Hydrobromide, Stramonium, Hyoscyamus Cannabis, Caffeine, Guarana

BELLADONNA

BELLADONNÆ FOLIA.—Belladonna Leaves. Adv.—Bellad. Fol. *Synonym.*—Deadly Night Shade Leaves. The dried leaves and tops of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), without the presence or admixture of more than 10 per cent. of its stems or other foreign matter and yielding not less than 0.3 per cent. of the total alkaloids of Belladonna Leaves. *Habitat.*—Europe and Asia Minor.

CHARACTERS.—Usually much twisted and matted together; leaves much crumpled; when soaked in water and spread out, the entire leaves from 6 to 20 cm. long, 4 to 12 cm. in breadth, broadly ovate, summits acute, margins entire, narrowed into the long petioles; upper surfaces brownish-green, lower surfaces grayish-green, epidermis more or less papillose, and slightly hairy; flowers with yellowish-purple, campanulate corollas, fruits globular, subtended by the calyx dark green or greenish-brown, and with numerous small seeds; odor distinct, especially on moistening; taste somewhat bitter and acrid.

Resembling Belladonna Leaves.—Stramonium leaves, more wrinkled; hyoscyamus leaves, hairy.

COMPOSITION.—The chief constituents are—(1) *Atropine* (*see* p. 121). (2) So-called *Belladonnine*, a yellowish powder, is probably *identical with Hyoscyamine* (*see* p. 124). It has been stated that Atropine does not exist in Belladonna in the natural state, but that it is a conversion product of Hyoscyamine, which is the natural alkaloid of Belladonna. Atropine, Daturine (*see* p. 123), Duboisine, Hyoscyamine (*see* p. 124) and Scopolamine (Hyoscine) (*see* p. 124), are derived from atropaceous plants and exist in them as malates.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Extractum Belladonnæ Foliorum.**—Extract of Belladonna Leaves. Abv.—Ext. Bellad. Fol. Extract of Belladonna Leaves yields not

less than 1.18 per cent. nor more than 1.32 per cent. of the alkaloids of Belladonna Leaves. By percolation with Alcohol and water, and evaporation.

Dose, 0.015 gm. = 15 milligm. (¼ gr.).

2. **Emplastrum Belladonnæ.**—Belladonna Plaster. Abv.—Emp. Bellad. An adhesive plaster, containing 30 per cent. of Extract of Belladonna Leaves and yielding not less than 0.35 per cent. nor more than 0.40 per cent. of the alkaloids from Belladonna Leaves.

3. **Tinctura Belladonnæ Foliorum.**—Tincture of Belladonna Leaves. Abv.—Tr. Bellad. Fol. Tincture of Belladonna Leaves yields not less than 0.027 per cent. nor more than 0.033 per cent. of the total alkaloids of Belladonna Leaves. By maceration and percolation.

Dose, 0.75 mil (12 ♏).

4. **Unguentum Belladonnæ.**—Belladonna Ointment. Abv.—Ung. Bellad. Pilular Extract of Belladonna Leaves, 10; Diluted Alcohol, 5; Hydrous Wool Fat, 20; Benzoinated Lard, 65.

BELLADONNÆ RADIX.—Belladonna Root. Abv.—Bellad. Rad. The dried root of *Atropa Belladonna* (Fam. *Solanaceæ*), without the presence or admixture of more than 10 per cent. of its stem-bases or other foreign matter, and yielding not less than 0.45 per cent. of the total alkaloids of Belladonna Root. *Habitat.*—Central and Southern Europe.

CHARACTERS.—Cylindrical or somewhat tapering, usually split into longitudinal pieces, from 0.5 to 2.5 cm. in thickness; externally pale brownish-gray longitudinally wrinkled, outer layers of the periderm rather soft, frequently abraded, and thus showing lighter patches; fracture nearly smooth, mealy, on breaking, emitting a puff of dust consisting chiefly of starch grains; internally whitish with a distinct cambium zone, and yellowish wood wedges; nearly inodorous; taste sweetish, afterwards bitterish and strongly acrid.

COMPOSITION.—As of the Leaves.

Dose, 0.045 gm. = 45 milligm. (¾ gr.).

Preparations

1. **Fluidextractum Belladonnæ Radicis.**—Fluidextract of Belladonna Root. Abv.—Fldext. Bellad. Rad. Fluidextract of Belladonna Root yields not less than 0.405 per cent. nor more than 0.495 per cent. of the total alkaloids of Belladonna Root. By percolation with Alcohol and Water, and evaporation.

Dose, 0.05 mil (1 ♏).

2. **Linimentum Belladonnæ.**—Belladonna Liniment. Abv.—Lin. Bellad. Camphor, 50; Fluidextract of Belladonna Root to 1000.

ATROPINA.—Atropine. Abv.—Atrop. $C_{17}H_{23}O_3N = 289.19$. An alkaloid obtained from *Belladonna* and from some other plants of the *Solanaceæ*. As it occurs in commerce, it is usually accompanied by a small proportion of Hyoscyamine, from which it cannot readily be separated.

SOURCE.—Atropine is made from the root thus:—(1) Make a tincture of the root by maceration and percolation with Alcohol. (2) Add slaked lime; this splits up the Atropine Malate, Lime Malate being precipitated. (3) Filter, and add Sulphuric Acid to precipitate the excess of Lime. (4) Filter, concentrate by distillation, partially evaporate, add Potassium Carbonate; after six hours much coloring matter is precipitated. (5) Filter, add more Potassium Carbonate; this sets free the Atropine. (6) Shake up with Chloroform, which takes up the Atropine in solution. (7) Withdraw the Chloroform, evaporate, and Atropine is left. It is purified by digestion with warm Alcohol and Animal Charcoal.

CHARACTERS.—White, rhombic prisms, odorless. *Great caution must be used in tasting it and then only in very dilute solution. Solubility.*—In 455 parts of water, 12 of Alcohol, 25 of Ether, 1 of Chloroform, and 27 parts of Glycerin; and in 90 parts of water at 80°C. (176°F.) in 1.2 parts of Alcohol at 60°C. (140°F.). It can be decomposed into Tropine and Tropic Acid, and reconstructed by their synthesis. It is distinguished from Hyoscyamine, with which it is isomeric, by its melting-point, optical properties and molecular constitution.

IMPURITIES.—Scopolamine (hyoscine), hyoscyamine, morphine, strychnine and other alkaloids, readily carbonizable organic impurities.

INCOMPATIBLES.—Caustic alkalies decompose it. Common to all alkaloids: Alkalies and their carbonates, benzoates, borax, bromides, cyanides, salts of gold or mercury, ichthyol, iodides, oxalic, picric and tannic acids, oxidizers (chlorates, chromates, hydrogen dioxide, permanganates, etc.), vegetable decoctions and infusions. *Physiological Incompatibles.*—Aconitine, hydrated chloral, hydrocyanic acid, morphine, physostigmine, pilocarpine, quinine.

Dose, 0.0005 gm. = 0.5 milligm. (1/120 gr.).

ATROPINÆ SULPHAS.—Atropine Sulphate. Abv.—Atrop. Sulph. $(C_{17}H_{23}O_3N)_2H_2SO_4 = 694.49$. The sulphate of the alkaloid Atropine.

SOURCE.—Dissolve Atropine in Diluted Sulphuric Acid, treat with Ether; the insoluble Sulphate is deposited.

CHARACTERS.—A white crystalline powder or microscopic needles or prisms; odorless; efflorescent in dry air. Great *caution must be used in tasting it and then only in very dilute solutions. Solubility.*—In 0.4 part of water, 5 parts of Alcohol, 2.5 parts of Glycerin; 3000 of Ether, and 420 of Chloroform at 25°C. (77°F.).

Dose, 0.0005 gm. = 0.5 milligm. (1/120 gr.).

For the Therapeutics of Belladonna and its Alkaloids *see* p. 714.

HOMATROPINÆ HYDROBROMIDUM.—Homatropine Hydrobromide. Abv.—Homatrop. Hydrobrom. $C_{16}H_{21}O_3N \cdot HBr = 356.11$. The hydrobromide of Homatropine, an alkaloid obtained by the condensation of Tropine and Mandelic Acid.

CHARACTERS.—A white, odorless, crystalline powder, or rhombic prisms. *Great caution must be used in tasting it and then only in very dilute solutions. Solubility.*—In 6 parts of water, 40 of Alcohol, and 420 parts of Chloroform at 25°C. (77°F.); in 12 parts of Alcohol at 60°C. (140°F.); insoluble in Ether.

IMPURITIES.—Atropine, scopolamine (hyoscine), hyoscyamine and other alkaloids.

Dose, 0.0005 gm. = 0.5 milligm. (1/120 gr.).

For the Therapeutics of Homatropine Hydrobromide *see* p. 720.

STRAMONIUM

STRAMONIUM. Abv.—Stramon. *Synonyms.*—Thorn apple. Stinkweed. Jamestown Weed. Jimson Weed. The dried leaves of *Datura Stramonium* Linné or of *Datula Tatula* Linné (Fam. *Solanaceæ*), without the admixture of more than 10 per cent. of stems or other foreign matter and yielding not less than 0.25 per cent. of the total alkaloids of Stramonium. *Habitat.*—Asia; naturalized in most countries.

CHARACTERS.—Usually much wrinkled either loose or more or less matted together; laminæ when entire, from 2 to 30 cm. in length, having petioles, form 0.5 to 8 cm. in length; inequilaterally ovate, summits acute or acuminate, bases unequal, one side extending from 3 to 12 mm. below the other, margins sinuate, toothed or angled, the teeth being few, acute or acuminate, and with rounded sinuses; frequently with numerous circular perforations, which may have become filled with cork; upper surfaces dark green, sparsely hairy especially upon the veins, lower surfaces light green; odor distinct, heavy and narcotic; taste unpleasant, nauseous. Stems cylindrical, usually flattened, attaining a length of 30 cm. and a diameter of 7 mm.; longitudinally wrinkled, occasionally with 1 or more deep furrows, light greenish-brown to purplish-brown.

Resembling Stramonium Leaves.—Belladonna Leaves, but less wrinkled; Hyoscyamus Leaves, hairy.

COMPOSITION.—The chief constituents are—(1) *Daturine* (0.02 to 0.03 per cent.), probably identical with Hyoscyamine. Usually a little Atropine is present, and the term Daturine is occasionally applied to the total alkaloids of Stramonium. (2) A fixed oil (25 per cent.), which contains *Daturic Acid* $C_{17}H_{14}O_3$.

INCOMPATIBLES.—Caustic alkalies, metallic salts, mineral acids.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Extractum Stramonii.**—Extract of Stramonium. Abv.—Ext. Stramon. Extract of Stramonium yields not less than 0.9 per cent. nor more than 1.1 per cent. of the total alkaloids of Stramonium. By percolation and evaporation.

Dose, 0.010 gm. = 10 milligm. (1/6 gr.).

2. **Tinctura Stramonii.**—Tincture of Stramonium. Abv.—Tr. Stramon. Tincture of Stramonium yields not less than 0.0225 per cent. nor more than 0.0275 per cent. of the total alkaloids of Stramonium. Stramonium, 100; Diluted Alcohol, by maceration and percolation to 1000.

Dose, 0.5 mil (8 ♏).

3. **Unguentum Stramonii.**—Stramonium Ointment. Abv.—Ung. Stramon. Pilular Extract of Stramonium, 10; Diluted Alcohol, 5; Hydrous Wool-Fat, 20; Benzoinated Lard, 65.

For the Therapeutics of Stramonium *see* p. 724.

HYOSCYAMUS

HYOSCYAMUS. Abv.—Hyos. *Synonym.*—Henbane. The dried leaves and flowering or fruiting tops of *Hyoscyamus niger* Linné (Fam. *Solanaceæ*), yielding not less than 0.065 per cent. of the alkaloids of Hyoscyamus. *Habitat.*—Europe and Asia; naturalized in some parts of North America.

CHARACTERS.—Usually much wrinkled, with numerous stems and with the flowering or fruiting tops intermixed; leaves when entire attaining a length of 25 cm., a breadth of 10 cm., ovate, or ovate-oblong, very inequilateral, the lower with short petioles, the upper sessile, summits acute, margins coarsely and angularly 1- to 4-toothed or lobed, grayish-green, glandular-hairy, particularly on the lower surfaces; flowers nearly sessile, with an urn-shaped, unequally 5-toothed calyx and a campanulate corolla, which in the fresh state is of a yellowish color; fruit a 2-locular pyxis, and enclosed in a large urn-shaped calyx with 5 acute teeth; odor heavy, distinctive; taste somewhat bitter and acrid.

Stems from 3 to 10 cm. in length and from 2 to 5 mm. in thickness, nearly cylindrical or somewhat compressed, longitudinally wrinkled and hairy.

COMPOSITION.—The chief constituents are—(1) *Hyoscyamine*, $C_{17}H_{23}NO_3$ an alkaloid. It is very closely allied to the alkaloids of Belladonna and Stramonium (*see* pp. 120 and 123) and is also contained in many plants of the natural order *Solanaceæ*. It, like Atropine, with which it is isomeric, consists of Tropic Acid and Tropine. There is in commerce an amorphous impure Hyoscyamine, which is a dark brown extract-like fluid having a disagreeable odor. As it is much cheaper than the crystalline alkaloid, it is often used, but this as well as other specimens should be proscribed. (2) *Scopolamine* (*Hyoscine*), a white crystalline alkaloid.

INCOMPATIBLES.—Vegetable acids, silver nitrate, lead acetate, alkalies.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparations

1. **Extractum Hyoscyami.**—Extract of Hyoscyamus. Abv.—Ext. Hyosc. By percolation and evaporation. It should yield not less than 0.22 per cent. nor more than 0.28 per cent. of the alkaloids of Hyoscyamus.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

2. **Fluidextractum Hyoscyami.**—Fluidextract of Hyoscyamus. Abv.—Fldext. Hyosc. By maceration and percolation with Alcohol and water, and evaporation. It should yield not less than 0.0055 per cent. nor more than 0.0075 per cent. of the alkaloids of Hyoscyamus.

Dose, 0.2 mil (3 ♏).

3. **Tinctura Hyoscyami.**—Tincture of Hyoscyamus. Abv.—Tr. Hyoscy. Hyoscyamus, 100; Diluted Alcohol to 1000. By maceration and percolation.

Dose, 2 mils (30 ♏).

HYOSCYAMINÆ HYDROBROMIDUM.—Hyoscyamine Hydrobromide. Abv.—Hyoscamin. Hydrobr. $C_{17}H_{23}O_3NHBr = 370.12$. The hydrobromide of Hyoscamine, an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ*.

SOURCE.—Prepared by dissolving 10 parts of Hyoscyamine in 11 parts of a 25 per cent. solution of Hydrobromic Acid, evaporating and crystallizing.

CHARACTERS.—White, prismatic crystals, without odor. *Great caution must be observed in tasting it, using only a very dilute solution. Solubility.*—Very soluble in water; soluble in 2.5 parts of Alcohol, 2260 of Ether and 1.7 of Chloroform.

IMPURITIES.—Atropine, scopolamine and other alkaloids, carbonizable impurities.

Dose, 0.0003 gm. = 0.3 milligm. (1/500 gr.).

SCOPOLAMINÆ HYDROBROMIDUM.—Scopolamine Hydrobromide. Abv.—Scopolamin. Hydrobrom. *Synonym.*—Hyoscine Hydrobromide. $C_{17}H_{21}O_4N \cdot HBr + 3H_2O = 438.15$. The Hydrobromide of lævorotatory Scopolamine, also known as Hyoscine, obtained from various plants of the *Solanaceæ*.

SOURCE.—Obtained by neutralizing the mother-liquors, from the seed of Hyoscyamus and Stramonium, remaining after removal of Hyoscyamine, with Hydrobromic Acid and adding Absolute Alcohol, when, after the lapse of some time, crystals of Scopolamine Hydrobromide will separate, and, which may be purified by recrystallization from hot Alcohol.

CHARACTERS.—Colorless, transparent, rhombic crystals, sometimes of large size, odorless, slightly efflorescent. *Great care must be used in tasting it and then only in dilute solutions. Solubility.*—In 1.5 parts of water, in 20 of Alcohol; slightly soluble in Chloroform; insoluble in Ether.

IMPURITIES.—Apoatropine, morphine, foreign alkaloids, carbonizable impurities.

Dose, 0.0003 gm. = 0.3 milligm. (1/500 gr.).

For the Therapeutics of Hyoscyamus and its Alkaloids *see* p. 725.

CANNABIS

CANNABIS. Abv.—Cannab. *Synonym.*—Indian Hemp. Guaza. Ganjah. The dried flowering tops of the pistillate plants of *Cannabis sativa* Linné or of the variety *indica* Lamarck (Fam. *Moraceæ*), freed from the thicker stems and large foliage leaves and without the presence or admixture of more than 10 per cent. of fruits or other foreign matter. Cannabis, made into a fluidextract in which 100 mils represent 100 gm. in this drug, when assayed biologically, produces incoördination when administered to dogs in a dose of not more than 0.03 mil of fluidextract per kilogramme of body weight. *Habitat.*—Asia; collected in India.

CHARACTERS.—In dark green or greenish-brown and more or less agglutinated fragments, consisting of the short stems with their leaf-like bracts and pistillate

flowers, some of the latter being replaced with more or less developed fruits; stems cylindrical, of varying length, not more than 3 mm. in diameter, longitudinally furrowed, light green to light brown, strigose-pubescent; leaves digitally compound; leaflets, when soaked in water and spread out, linear-lanceolate, nearly sessile, margin deeply serrate; bracts ovate, pubescent, each enclosing one or more pistillate flowers, or more or less developed fruits; calyx dark green, pubescent and somewhat folded around the ovary or fruit; styles two, filiform and pubescent; ovary with a single campylotropous ovule; fruit light green to light brown, broadly ellipsoidal, about 3.5 mm. in length, finely wrinkled and slightly reticulated; odor agreeably narcotic; taste characteristic.

COMPOSITION.—The chief constituents are—(1) *Cannabinon*, a soft resin. (2) *Choline*, $C_5H_{15}NO_2$, which is contained in (3) *Tetanocannabine*, and with alkalies gives (4) *Cannabinine*. (5) *Cannabin*, a brown, amorphous resin, said to be very active.

INCOMPATIBLES.—Water (which precipitates the resin), caustic alkalies.

Preparations

1. **Extractum Cannabis.**—Extract of Cannabis. Abv.—Ext. Cannab. When assayed biologically it produces incoördination when administered to dogs in dose of not more than 0.004 gm. of extract per kilogramme of body weight. By maceration and percolation with Alcohol, and evaporation.

Dose, 0.010 gm. = 10 milligm. (⅙ gr.).

2. **Fluidextractum Cannabis.**—Fluidextract of Cannabis. Abv.—Fldext. Cannabis. It is of the strength, when assayed biologically as Cannabis. By maceration, percolation with Alcohol, which is distilled off, and evaporation.

Dose, 0.1 mil (1½ ♏).

3. **Tinctura Cannabis.**—Tincture of Cannabis. Abv.—Tr. Cannab. It is of the same strength when assayed biologically as Cannabis. By maceration and percolation.

Dose, 0.75 mil (12 ♏).

Haschisch is a confection of the drug. Ganjah, or Ganga, is the dried flowering tops of the cultivated female plants which are coated with resin. Churrus, or Charas, is the resin scraped from the leaves. Bhang, or Siddhi, is the dried leaves and stalks made with preserved fruits into a confection. In some provinces it means powdered Ganga made into a drink. Ganga and Charas are often smoked like tobacco.

For the Therapeutics of Cannabis *see* p. 744.

CAFFEINA

CAFFEINE. $C_8H_{10}O_2H_4+H_2O$ or $C_5H(CH_3)_3O_2N_4+H_2O=212.14$.

Synonyms.—Theine. Guaranine. A feebly basic substance [$C_5H(CH_3)_3O_2N_4 + H_2O$], obtained from the leaves of *Thea sinensis* Linné (Fam. *Ternstræmiaceæ*), or from the seeds of *Coffea arabica* Linné (Fam. *Rubiaceæ*); also

occurring in other plants; or prepared synthetically. *Habitat.*—Tropical Africa; cultivated in tropical countries.

SOURCE.—Exhaust bruised coffee by successive portions of boiling water, precipitate with Lead Acetate, decompose the excess of Lead Acetate in the filtrate by Hydrogen Sulphide, concentrate by evaporation, neutralize with Ammonia. The Caffeine crystallizes on cooling, and is purified by re-dissolving in water, treating with Animal Charcoal, and evaporation. Commercially it is prepared almost exclusively from tea and tea dust or sweepings containing it.

CHARACTERS.—White, flexible, silky glistening needles, usually matted together in fleecy masses, odorless, and having a bitter taste; efflorescent in dry air. *Solubility.*—In 46 parts of water, 66 of Alcohol, 530 of Ether, and 5.5 of Chloroform. Tea contains 3 to 5 per cent., Coffee, 1.3 per cent. (coffee leaves contain much more), Guarana (the seeds of *Paullinia Cupana*), 4 per cent. Maté (Paraguay tea, the leaves of *Ilex paraguayensis*), 1.2 per cent., Kola nut (which is used as a beverage in Africa), 3 per cent.; this is the fruit of *Sterculia acuminata*. Caffeine is trimethyl-xanthine, Theobromine is dimethyl-xanthine, and both can be prepared synthetically from xanthine.

IMPURITIES.—Other alkaloids, organic impurities.

INCOMPATIBLES.—Potassium iodide, mercury salts, tannic acid. *Physiological Incompatibles.*—Hydrated chloral, morphine, physostigmine.

Dose, 0.150 gm. = 150 milligm. (2½ gr.).

Preparations

1. **Caffeina Citrata.**—Citrated Caffeine. Abv.—Caffein. Cit. It contains, when dried to constant weight, not less than 48 per cent. of anhydrous Caffeine ($C_8H_{10}O_2N_4 = 194.12$.) Dissolve Citric Acid, 50, in hot Distilled Water, 100; add Caffeine, 50, and evaporate the resulting solution on a water-bath to dryness, constantly stirring towards the end of the operation. Reduce the product to a fine powder.

CHARACTERS.—A white powder, odorless, and having a slightly bitter, acid taste. *Solubility.*—Citrated Caffeine forms a clear, syrupy solution with a small quantity of water but precipitates on dilution; upon further dilution this precipitate redissolves.

IMPURITIES.—Tartaric acid.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

2. **Caffeina Citrata Effervescens.**—Effervescent Citrated Caffeine; Abv.—Caff. Cit. Eff. It contains not less than 1.9 per cent. of anhydrous Caffeine ($C_8H_{10}O_2N_4 = 194.12$). Caffeine, 40; Citric Acid, 195; Sodium Bicarbonate, 570; Tartaric Acid, 300. Powder the Citric Acid and mix it intimately with the Citrated Caffeine and Tartaric Acid, then thoroughly incorporate the Sodium Bicarbonate. Place the mixed powders on a plate of glass or in a suitable dish, in an oven heated to between 93° and 104°C. (199.4° and 219.2°F.). When the mixture, by the aid of careful manipulation with a wooden spatula, has become moist rub it through a tinned-iron

sieve, and dry the granules at a temperature not exceeding 54°C. (129.2°F.).

Dose, 4 gm. (60 gr.).

CAFFEINÆ SODIO-BENZOAS.—Caffeine Sodio-Benzoate. Abv.—Caff. Sod. Benz. A mixture of Caffeine and Sodium Benzoate, containing, when dried to constant weight, not less than 46 per cent. nor more than 50 per cent. of anhydrous Caffeine ($C_8H_{10}O_2N_4 = 194.12$), the remainder being Sodium Benzoate ($NaC_7H_5O_2 = 144.04$).

CHARACTERS.—A white powder; odorless and having a slightly bitter taste. *Solubility.*—In 1.1 parts of water, some Caffeine separating on standing; in 30 parts of Alcohol at 25°C. (77°F.); partly soluble in Chloroform.

IMPURITIES.—Readily carbonizable organic water.

Dose (by mouth), **0.3 gm. = 300 milligm. (5 gr.)**, (hypodermatic) **0.2 gm. = 200 milligm. (3 gr.).**

For the Therapeutics of Caffeine *see* p. 727.

GUARANA

GUARANA. *Synonym.*—Brazilian Cocoa. A dried paste consisting chiefly of the crushed seeds of *Paullinia Cupana* Kunth (Fam. *Sapindaceæ*), yielding not less than 4 per cent. of Caffeine. *Habitat.*—Northern and Western Brazil

CHARACTERS.—Usually in cylindrical sticks, about 3 to 5 cm. in diameter, externally dark reddish-brown; hard and heavy; fracture uneven, often fissured in the centre, internally pale reddish-brown, showing more or less coarse fragments of seeds and occasionally their blackish-brown integuments; odor slight; taste slightly astringent, and bitter.

COMPOSITION.—The chief constituents are—(1) *Caffeine* (*see* p. 126), 4 per cent.; (2) Volatile Oil, a trace; (3) Saponin; (4) Tannic Acid.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Guaranæ.—Fluidextract of Guarana. Abv.—Fldext. Guaran. It should yield not less than 3.6 per cent. nor more than 4.4 per cent. of Caffeine. By maceration and percolation with diluted Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

For the Therapeutics of Guarana *see* p. 733.

CLASS II.—DRUGS ACTING CHIEFLY ON THE SPINAL CORD

A. DRUGS WHICH EXCITE THE ANTERIOR CORNUA

Nux Vomica, Strychnine

NUX VOMICA

NUX VOMICA. Abv.—Nux Vom. *Synonyms.*—Poison Nut. Dog Button. Quaker Button. The dried, ripe seeds of *Strychnos Nux-vomica* Linné, (Fam.

Loganiaceæ), yielding not less than 2.5 per cent. of the alkaloids of Nux Vomica. *Habitat.*—India and East Indian Islands.

CHARACTERS.—Orbicular nearly flat, occasionally irregularly bent, 10 to 30 mm. in diameter, and from 4 to 5 mm. in thickness, very hard when dry; externally grayish or greenish-gray, covered with appressed hairs giving it a silky lustre, hilum indicated by a circular scar at the centre of one of the flattened sides and connected with the micropyle at the edge by a ridge; internally showing a thin, hairy seed-coat and a large grayish-white endosperm at one end of which is embedded a small embryo with two broadly ovate 5- to 7-nerved cotyledons; inodorous; taste intensely and persistently bitter.

COMPOSITION.—The chief constituents are—(1) *Strychnine* (*see* below), 0.9 to 1.9 per cent.; (2) *Brucine*, $C_{23}H_{26}N_2O_4$, 0.9 to 1.5 per cent. in colorless prismatic crystals or pearly flakes. Very bitter but less so than Strychnine. *Solubility.*—Freely in Alcohol, and in 7 parts of Chloroform. It has the same action as Strychnine, but is considerably less powerful and slower in its effects. Strong Sulphuric or Nitric Acid gives a blood-red color. (3) *Igasuric Acid*, with which the Strychnine and Brucine are united. (4) Loganin, $C_{18}H_{24}O_{14}$, in colorless prisms, an inert glucoside.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Extractum Nucis Vomicæ.**—Extract of Nux Vomica. Abv.—Ext. Nux Vom. It yields not less than 15.2 per cent. nor more than 16.8 per cent. of the alkaloids of Nux Vomica. By maceration, percolation, filtration and evaporation.

Dose, 0.015 gm. = 15 milligm. (¼ gr.).

2. **Fluidextractum Nucis Vomicæ.**—Fluidextract of Nux Vomica. Abv.—Fldext. Nuc. Vom. It yields not less than 2.37 per cent. nor more than 2.63 per cent. of the alkaloids of Nux Vomica. By digestion, percolation and evaporation.

Dose, 0.05 mil (1 ♏).

3. **Tinctura Nucis Vomicæ.**—Tincture of Nux Vomica. Abv.—Tr. Nuc. Vom. It yields not less than 0.237 per cent. nor more than 0.263 per cent. of the alkaloids of Nux Vomica. Nux Vomica, 100: with Alcohol and water.

Dose, 0.5 mil (8 ♏). By percolation.

STRYCHNINA.—Strychnine. Abv.—Strych. $C_{21}H_{22}O_2N_2 = 334.20$. An alkaloid obtained from Nux Vomica, and also obtainable from the seeds of other *Loganiaceæ*.

SOURCE.—(1) Comminute the Nux Vomica; (2) Extract the Strychnine with water acidulated with Hydrochloric Acid; (3) Concentrate the infusion, decompose the Strychnine with Lime; (4) Extract the Strychnine from the precipitate with boiling Alcohol; (5) Concentrate the solution to obtain the crystals.

CHARACTERS.—Colorless, transparent, prismatic crystals, or a white crystalline powder; odorless, and permanent in the air. *Strychnine and its salts should be tasted with extreme caution, and then only in very dilute solutions*, which are exceedingly bitter. *Solubility.*—In 6420 parts of water, 136 of Alcohol, 5 of Chloroform, 180 of Benzene, at 25°C. (77°F.). *Resembling Strychnine.*—Artificial Salicylic Acid *see* p. 156.

IMPURITIES.—Brucine, sugar and other readily carbonizable organic impurities.

INCOMPATIBLES.—Alkalies, ammonium chloride, mercuric chloride, gold chloride, tannic, oxalic, and picric acids, borax, piperazine, benzoates, cyanides, bichromates, ichthyol, salicylates, iodides and bromides; the last are especially dangerous, for the precipitated strychnine bromide falls slowly.

The same incompatibles apply to the salts of Strychnine.

Dose, 0.0015 gm. = 1.5 milligm. (1/40 gr.).

STRYCHNINÆ NITRAS.—Strychnine Nitrate. Abv.—Strych. Nit. $C_{21}H_{22}O_2N_2 \cdot HNO_3 = 397.21$. The nitrate of the alkaloid Strychnine.

SOURCE.—Obtained by the action of Nitric Acid on Strychnine, filtration and evaporation.

CHARACTERS.—Colorless, glistening needles or as a white, crystalline powder; odorless, permanent in the air. *Great caution should be used in tasting it and then only in very dilute solutions*, which are exceedingly bitter. *Solubility.*—In 32 parts of water, 150 of Alcohol, 105 of Chloroform, and 50 of Glycerin; insoluble in Ether.

IMPURITY.—Brucine.

Dose, 0.0015 gm. = 15 milligm. (1/40 gr.).

STRYCHNINÆ SULPHAS.—Strychnine Sulphate. Abv.—Strych. Sulph. $(C_{21}H_{22}O_2N_2)_2 \cdot H_2SO_4 + 5H_2O = 856.56$. The sulphate of the alkaloid Strychnine.

SOURCE.—By the action of Diluted Sulphuric Acid on Strychnine, filtration and evaporation.

CHARACTERS.—Colorless or white, prismatic crystals, or a white, crystalline powder; odorless and efflorescent in dry air. *Great caution should be used in tasting it and then only in very dilute solutions* which are exceedingly bitter. *Solubility.*—In 32 parts of water, 81 of Alcohol, and 220 of Chloroform at 25° C. (77°F.); insoluble in Ether.

IMPURITY.—Brucine.

Dose, 0.0015 gm. = 1.5 milligm. (1/40 gr.).

For the Therapeutics of Nux Vomica and its Alkaloid *see* p. 694.

B. DRUGS WHICH DEPRESS THE ANTERIOR CORNUA

Physostigma, Gelsemium

PHYSOSTIGMA

PHYSOSTIGMA. Abv.—Physotig. *Synonyms.*—Calabar bean. Ordeal bean. The dried ripe seeds of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*) yielding not less than 0.15 per cent. of alkaloids of Physostigma. *Habitat.*—Tropical Western Africa, near the mouth of the Niger and old Calabar.

CHARACTERS.—Oblong or ellipsoidal, somewhat compressed reniform, from 15 to 30 mm. in length, and from 10 to 15 mm. in thickness; externally reddish or chocolate brown, smooth, somewhat wrinkled near the brownish-black groove, the latter being about 2 mm. in width and extending almost the entire length of the convex edge and in which are found frequently the remains of the white membranous funiculus, the margins of the seed-coat on both sides of the groove somewhat elevated, of a yellowish-red or brownish-red color and somewhat thickened; embryos large, white, with a short hypocotyl and two concavo-convex cotyledons; taste at first starchy, afterwards acrid.

COMPOSITION.—The chief constituents are:—(1) *Physostigmine* or *Eserine* (*see* below); (2) *Calabarine*, a derivative of *Physostigmine;* (3) *Eseridine;* and (4) Physosterin, a neutral principle closely related to cholesterin.

Dose, 0.100 gm. = 100 milligm. (1½ gr.).

Preparations

1. **Extractum Physostigmatis.**—Extract of Physostigma. Abv.—Ext. Physostig. It should yield not less than 1.7 per cent. nor more than 2.3 per cent. of the alkaloids of Physostigma. By maceration, and percolation with Tartaric Acid, 5; Alcohol and water; treatment with Purified Petroleum Benzin, which is decanted, and evaporation.

Dose, 0.008 gm. = 8 milligm. (⅛ gr.).

2. **Tinctura Physostigmatis.**—Physostigma. Abv.—Tr. Physostig. It should yield not less than 0.013 per cent., nor more than 0.017 per cent. in the alkaloids of Physostigma. By maceration and percolation with Alcohol.

Dose, 1 mil (15 ♏).

PHYSOSTIGMINÆ SALICYLAS.—Physostigmine Salicylate. Abv.—Physostig. Salicyl. *Synonym.*—Eserine Salicylate. $C_{15}H_{21}O_2N_3 \cdot C_7H_6O_3 = 413.25$. The salicylate of an alkaloid obtained from Physostigma.

SOURCE.—By adding Physostigmine to a solution of Salicylic Acid in boiling Distilled Water, and allowing the salt to crystallize on cooling.

CHARACTERS.—Colorless or faintly yellowish, shining, acicular, or short, columnar crystals; odorless. *It should be tasted with great caution.* It acquires a reddish tint when long exposed to light and air. *Solubility.*—In 75 parts of water, 16 of Alcohol, 250 of Ether, and 6 parts of Chloroform at 25°C. (77°F.).

IMPURITY.—Physostigmine sulphate and readily carbonizable impurities.

Dose, 0.001 gm. = 1 milligm. (1/60 gr.).

For the Therapeutics of Physostigma *see* p. 701.

GELSEMIUM

GELSEMIUM. Abv.—Gelsem. *Synonyms.*—Yellow Jasmine, Yellow Jessamine. The dried rhizome and roots of *Gelsemium sempervirens* (Linné) Aiton filius (Fam. *Loganiaceæ*). *Habitat.*—Southern United States.

CHARACTERS.—Rhizome cylindrical, usually in pieces from 3 to 20 cm. in length and from 3 to 30 mm. in diameter; externally light yellowish-brown, longitudinally wrinkled, with purplish brown longitudinal lines and transverse fissures; the upper surface with few stem-scars, the under and side portions with numerous roots and root-scars; fracture tough, splintery; internally light brown or pale yellow, bark thin, wood distinctly radiate, excentral, pith disintegrated; odor slight; taste bitter. Roots light brown; fracture one-half transverse, the other oblique or splintery.

COMPOSITION.—The chief constituents are—(1) *Gelsemine*, $C_{54}H_{68}N_4O_{12}$, a colorless, with difficulty crystallizable, bitter alkaloid, soluble in Alcohol and Ether, sparingly in water. (2) *Gelseminine*, a brown, amorphous, bitter alkaloid, very poisonous. (3) *Gelseminic Acid*. (4) A volatile oil.

Dose, 0.03 gm. = 30 milligm. (½ gr.).

Preparations

1. **Extractum Gelsemii.**—Extract of Gelsemium. Abv.—Ext. Gelsem One part of the Extract represents 4 parts of Gelsemium. By percolation, maceration with Alcohol and evaporation.

Dose, 0.01 gm. = 10 milligm. (⅙ gr.).

2. **Fluidextractum Gelsemii.**—Fluidextract of Gelsemium. Abv.—Fldext. Gelsem. By maceration and percolation with Alcohol and water and evaporation.

Dose, 0.03 mil (½ ♏).

3. **Tinctura Gelsemii.**—Tincture of Gelsemium. Abv.—Tr. Gelsem. By maceration and percolation with Alcohol and water.

Dose, 0.25 mil. (4 ♏).

For the Therapeutics of Gelsemium *see* p. 705.

CLASS III.—DRUGS ACTING CHIEFLY ON THE NERVES

A. DRUGS WHICH DEPRESS THE SENSORY NERVES

Cocaine

COCAINA

COCAINE. Abv.—Cocain. $C_{17}H_{21}O_4N$ or $C_5H_{13}(C_6H_5CO)ON.COOCH_3$ = 303.18. An alkaloid obtained from *Erythroxylon Coca* Lamarck and its varieties (*Fam. Erythroxylaceæ*).

SOURCE.—Coarsely ground Coca leaves are re-percolated with an aqueous 5 per cent. solution of Sulphuric Acid, by which a very dense, slightly acid percolate is obtained; this is thoroughly agitated with pure Coal Oil and an excess of Sodium Carbonate; the liberated alkaloid is retained by the Coal Oil, and is nearly free

from coloring matter; the oily solution is then agitated with acidulated water, and again precipitated by Sodium Carbonate in the presence of Ether.

CHARACTERS.—Large, colorless, four-sided or six-sided, monoclinic prisms, or a white crystalline powder; it has a slightly bitter taste, producing on the tongue a temporary numbness. *Solubility.*—In 600 parts of water; in 6.5 parts of Alcohol; in 0.7 part of Chloroform; and 3.5 of Ether; and in 12 parts of Olive Oil; very soluble in warm Alcohol; slightly soluble in Liquid Petroleum.

IMPURITIES.—Cinnamyl-cocaine and isotropyl-cocaine.

INCOMPATIBLES.—Mineral acids (decompose cocaine into benzoic acid and ecgonine), alkalies, bromides of the alkalies, chloroform water, menthol, mercury salts, silver nitrate.

Dose, 0.015 gm. = 15 milligm. (¼ gr.).

COCAINÆ HYDROCHLORIDUM.—Cocaine Hydrochloride. Abv.—Cocain. Hydrochlor. $C_{17}H_{21}O_4N \cdot HCl = 339.65$. The hydrochloride of the alkaloid Cocaine.

SOURCE.—Agitate with Ether an aqueous solution of an acidulated Alcoholic extract, make alkaline with Sodium Carbonate; separate and evaporate the Ethereal liquid; purify by repetition; decolorize, neutralize with Hydrochloric Acid, and re-crystallize.

CHARACTERS.—Colorless, transparent, monoclinic prisms; or in flaky, lustrous leaflets, or a white, crystalline powder; odorless; of a saline, slightly bitter taste, and producing upon the tongue a tingling sensation followed by numbness of several minutes' duration; permanent in the air. *Solubility.*—In 0.4 part of water, 3.2 parts of Alcohol, and 12.5 parts of Chloroform; soluble in Glycerin; insoluble in Ether.

IMPURITIES.—The same as of Cocaine.

INCOMPATIBLES.—The same as of Cocaine. *Physiological Incompatibles.*—Alcohol, amyl nitrite, caffeine, digitalis, hydrated chloral, morphine.

Dose, 0.015 gm. = 15 milligm. (¼ gr.).

For the Therapeutics of Cocaine *see* p. 688.

B. DRUGS WHICH STIMULATE THE SECRETORY NERVES

Pilocarpus

PILOCARPUS

PILOCARPUS. Abv.—Pilocarp. *Synonym.*—Jaborandi. The dried leaflets of *Pilocarpus Jaborandi* Holmes, known in commerce as Pernambuco Jaborandi or of *Pilocarpus microphyllus* Stapf, known in commerce as Maranham Jaborandi (Fam. *Rutaceæ*); without the presence or admixture of more than 5 per cent. of the stalks bearing the leaflets and stems of the same plant, or other matter and yielding, not less than 0.6 per cent. of the alkaloids of Pilocarpus. *Habitat.*—Brazil and Paraguay.

CHARACTERS. *Pilocarpus Jaborandi.*—Leaflets when entire, oval, oblong, or eliptical, from 4 to 10.5 cm. in length and from 2 to 4 cm. in breadth and with

short, stout petioles; summits more or less rounded or acute and emarginate; bases round or acute and mostly unequal; margins entire and narrowly revolute; very smooth, shiny, coriaceous and glandular-punctate; upper surfaces grayish to brownish-green, midribs mostly depressed, under surfaces yellowish- or greenish-brown and slightly pubescent on the prominent midvein, peculiarly aromatic when crushed; taste bitterish, becoming somewhat pungent and having a sialagogue effect.

Pilocarpus microphyllus.—Leaflets rhomboidally oval to obovate or eliptical, from 1.5 to 5 cm. in length and from 1 to 3 cm. in breadth, the lateral ones nearly sessile, the terminal ones on margined petioles, from 0.5 to 1.5 cm. in length; of a nearly uniform grayish or yellow-green color, rather thin but otherwise resembling Pernambuco Jaborandi.

IMPURITIES.—Leaves of species of Piper, not oval-oblong.

COMPOSITION.—The chief constituents are—(1) A liquid alkaloid, *Pilocarpine* $C_{11}H_{16}N_2O_2$, ½ to 1 per cent. (2) *Isopilocarpine*, isomeric with Pilocarpine, obtained, in varying amount as a colorless viscid oil, boiling at 261°C. (501.8°F.), which can be distilled without decomposition. (3) A volatile oil, chiefly a terpene (*Pilocarpene*, $C_{10}H_{16}$), about 0.5 per cent. (4) *Pilocarpidine*, $C_{10}H_{14}N_2O_2$, a decomposition product whose action is weaker than Pilocarpine, is found in *P. Jaborandi*, but not in *P. microphyllus*.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Pilocarpi.—Fluidextract of Pilocarpus. Abv.—Fldext. Pilocarp. One hundred mils of the Fluidextract of Pilocarpus yields not less than 0.55 gm. nor more than 0.65 gm. of the alkaloids of Pilocarpus. By maceration and percolation with Alcohol and water and standardization.

Dose, 2 mils (30 ♏).

PILOCARPINÆ HYDROCHLORIDUM.—Pilocarpine Hydrochloride. Abv.—Pilocarpin. Hydrochlor. $C_{11}H_{16}O_2N_2HCl$ = 244.62. The hydrochloride of an alkaloid obtained from Pilocarpus.

SOURCE.—Obtained by neutralizing Pilocarpine with diluted Hydrochloric Acid, concentrating the solution, and then setting it aside, over Sulphuric Acid, to crystallize.

CHARACTERS.—Colorless, translucent crystals, odorless and having a faintly bitter taste; hygroscopic on exposure to air. *Solubility.*—In 0.3 part of water in 3 of Alcohol, and in 366 parts Chloroform; insoluble in Ether.

IMPURITY.—Other alkaloids.

INCOMPATIBLES.—Silver nitrate, mercuric chloride, calomel, gold salts, potassium permanganate, tannin, iodides, alkalies.

Dose (by mouth), 0.010 gm. = 10 milligm. (⅙ gr.); (by hypodermatic injection) 0.005 gm. = 5 milligm. (1/12 gr.).

PILOCARPINÆ NITRAS.—Pilocarpine Nitras. Abv.—Pilocarpin. Nit. $C_{11}N_{16}O_2N_2HNO_3$ = 271.17. The nitrate of an alkaloid obtained from Pilocarpus.

SOURCE.—By neutralizing diluted Nitric Acid with pure Pilocarpine, concentration and crystallization.

CHARACTERS.—Shining crystals, odorless, permanent in the air. *Solubility.*—In 4 parts of water and 75 of alcohol; insoluble in Ether and Chloroform.

IMPURITIES.—Pilocarpine hydrochloride and other alkaloids.

INCOMPATIBLES.—The same as for the chloride.

Dose (by mouth), 0.010 gm. = 10 milligm. (⅙ gr.); (by hypodermatic injection) 0.005 gm. = 5 milligm. (1/12 gr.).

For the Therapeutics of Pilocarpus and its Alkaloid *see* p. 551.

GROUP II.—Drugs whose Main Action is on the Heart

CLASS I.—THE DIGITALIS GROUP, DECREASING THE FREQUENCY AND INCREASING THE FORCE OF THE BEAT OF THE HEART

Digitalis, Strophanthus, Squill, Sparteine Sulphate, Camphor

DIGITALIS

DIGITALIS. Ab.—Digit. *Synonym.*—Foxglove. The carefully dried leaves of *Digitalis purpurea* Linné (Fam. *Scrophulariaceæ*), without the presence or admixture of more than 2 per cent. of stems, flowers or other foreign matter. If made into the official tincture, and assayed biologically, the minimum lethal dose should not be greater than 0.006 mil of Tincture, or the equivalent in Tincture of 0.0000005 gm. of Ouabain, for each gramme of body weight of frog.

Habitat.—Europe, in sandy soil and the edges of woods.

CHARACTERS.—Leaves, when entire, attaining a length of 30 cm. and a breadth of 15 cm. ovate to oval, abruptly contracted into winged petioles, the latter from 5 to 10 cm. in length, or, in the smaller leaves, nearly absent; margin crenate, irregular (the commercial article usually more or less crumpled and broken), thin, dull, pale green or gray and densely pubescent on the lower surfaces; upper surfaces wrinkled, sparsely hairy; the venation conspicuously reticulated; the midribs and principal veins broad and flat, often purplish, the lower veins continued into the wings of the petioles, odor slight, characteristic; taste strongly bitter.

Resembling Digitalis leaves.—Matico leaves, which are more deeply reticulated.

COMPOSITION.—The chief constituents are—(1) *Digitoxin*, a glucoside, crystallizable, the most active principle, very poisonous, cumulative. Insoluble in water, sparingly in Ether, easily in Chloroform and Alcohol. Exists in minute white crystals. Dose, 0.00025 to 0.000125 gm.; 1/250 to 1/500 gr. (2) *Digitalin*, a crystalline glucoside, possessing in a high degree the actions of Digitalis. It is also called Digitalinum Verum. Soluble in water, 1 to 1000. Dose, 0.0003 to 0.0006 gm.; 1/200 to 1/100 gr. subcutaneously. (3) *Digitalein*, an amorphous glucoside not yet proved to be a definite chemical substance. Soluble in water, and, therefore, suitable for hypodermatic injections; dose 0.0006 gm.; 1/100 gr.,

said to be non-cumulative. These three glucosides are believed to represent the cardiac stimulating action of the drug. (4) ***Digitonin***, a glucoside closely allied both chemically and physiologically to, and perhaps identical with, the *Saponin* of Senega (*see* p. 143), which probably renders the other active principles soluble in water. This is a cardiac depressant, and is, therefore, antagonistic to the other active principles. (5) Digitin, a glucoside devoid of physiological action. All these five glucosides are non-nitrogenous. (6) Digitalic and Antirrhinic acids. (7) Other usual constituents of plants, as tannic acid, volatile oil, coloring matter, starch, sugar, gum, salts. It will be noticed that Digitalis contains no alkaloids.

INCOMPATIBLES.—Acids, alkalies, alkaloidal precipitants (among which are included picric and tannic acids, auric chloride, iodine in a solution of potassium iodide, and potassio-mercuric iodide), ferrous sulphate, lead acetate, vegetable astringents. *Physiological Incompatibles.*—Aconite, cocaine, hydrated chloral nitroglycerin, strychnine.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Fluidextractum Digitalis.**—Fluidextract of Digitalis. Abv.—Fldext. Digital. If assayed biologically the minimum lethal dose should not be greater than 0.0006 mil or its equivalent in Fluidextract of 0.0000005 gm. of Ouabain, for each gramme of body weight of frog. By maceration and percolation with alcohol and water and evaporation.

Dose, 0.05 mil (1 ♏).

2. **Infusum Digitalis.**—Infusion of Digitalis. Abv.—Infus. Digit. Digitalis, 15; Cinnamon Water, 150; boiling water, 500; water to 1000. *Infusion of Digitalis must be freely prepared from the leaves.*

Dose, 4 mils (1 fl. dr.).

3. **Tinctura Digitalis.**—Tincture of Digitalis. Abv.—Tr. Digit. If assayed biologically the minimum lethal dose should not be greater than 0.006 mil or its equivalent in Tincture of 0.0000005 gm. of Ouabain, for each gramme of body weight of frog. Digitalis, 100; Diluted Alcohol to 1000. By maceration and percolation.

Dose, 0.5 mil (8 ♏).

For the Therapeutics of Digitalis *see* p. 429.

STROPHANTHUS

STROPHANTHUS. Abv. —Strophanth. The dried ripe seeds of *Strophanthus Kombé* Oliver or of *Strophanthus hispidus* De Candolle (Fam. *Apocynaceæ*), deprived of the long awns. If made into the official tincture and assayed biologically the minimum lethal dose should not be greater than 0.00006 mil of Tincture, or the equivalent of 0.0000005 gm. of Ouabain, for each gramme of body weight of frog. *Habitat.*—Tropical Africa.

CHARACTERS.—Lance-ovoid, flattened and obtusely edged; from 7 to 20 mm. in length, about 4 mm. in breadth and about 2 mm. in thickness; externally of a light fawn color, with a distinct greenish tinge, silky-lustrous from a dense coating of closely appressed hairs (*S. Kombe*); or light to dark brown, nearly smooth and sparingly hairy (*S. hispidus*), bearing on one side a ridge running from about the center to the summit; fracture short and somewhat soft, the fractured surface whitish and oily; odor heavy when the seeds are crushed and moistened; taste very bitter.

COMPOSITION.—The chief constituents are—(1) *Strophanthin*, $C_{31}H_{48}O_{12}$. It exists in all parts of the plant but mostly in the seeds (8 to 10 per cent.). It is a transparent, white, imperfectly crystalline, bitter glucoside (being split up by acids into glucose and *Strophanthidin*). Very soluble in water; insoluble in Chloroform and Ether. (2) *Kombic Acid*, which is not identical in all varieties. (3) Ineine, an alkaloid probably inert. (4) Tanghinin, $C_{17}H_{40}O_8$, in rhombic prisms.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparation

Tinctura Strophanthi.—Tincture of Strophanthus. Abv.—Tr. Strophanth. If assayed biologically the minimum lethal dose should not be greater than 0.00006 mil of Tincture, or the equivalent in Tincture of 0.0000005 gm. of Ouabain, for each gramme of body weight of frog. Strophanthus, 100. By maceration and percolation with Alcohol and water.

Dose, 0.5 mils (8 ♏).

STROPHANTHINUM.—Strophanthin. A glucoside, or mixture of glucosides, obtained from Strophanthus, *Kombe* Oliver (Fam. *Apocyanceæ*).

CHARACTERS.—A white or yellowish powder, containing varying amounts of water which it does not lose entirely without decomposition. Permanent in the air. *Great caution should be used in tasting it and then only in very dilute solutions. Solubility.*—Very soluble in water and in Diluted Alcohol; less soluble in Dehydrated Alcohol; nearly insoluble in Ether, Chloroform and Benzene.

Dose (by mouth), **0.001 gm. = 1 milligm. (1/60 gr.)**; (intravenous) **0.00075 gm. = 0.75 milligm. (1/80 gr.).**

For the Therapeutics of Strophanthus see p. 443.

SCILLA

SQUILL. Abv.—Scill. *Synonym.*—Sea Onion. The fleshy inner scales of the bulb of the white variety of *Urginea maritima* (Linné) Baker (Fam. *Liliaceæ*), cut into pieces and carefully dried. If made into the official tincture and assayed biologically the minimum lethal dose should not be greater than 0.006 mil of Tincture, or the equivalent in Tincture of 0.0000005 gm. of Ouabain, for each gramme of body-weight of frog. *Habitat.*—Basin of the Mediterranean near the sea.

CHARACTERS.—In irregular, more or less curved, somewhat flattened pieces, from 0.5 to 5 cm. in length, yellowish-white; somewhat translucent, nearly smooth and lustrous, with slight projections of fibro-vascular bundles; brittle when dry and somewhat flexible when damp; odor slight; taste bitter and acrid.

COMPOSITION.—The chief constituents are—(1) *Scillitoxin*, the most active principle; (2) *Scillipicrin*, acting upon the heart; (3) *Scillin*, producing numbness and vomiting; (4) Mucilage.

Dose, 0.1 gm. = 100 milligm. (1½ gr.).

Preparations

1. **Acetum Scillæ.**—Vinegar of Squill. Abv.—Acet. Scill. Squill, 100; Diluted Acetic Acid, by maceration and filtration, to 1000.

Dose, 1 mil (15 ♏).

2. **Fluidextractum Scillæ.**—Fluidextract of Squill. Abv.—Fldext. Scill. If assayed biologically the minimum lethal dose should not be greater than 0.0006 mil of Fluidextract or the equivalent of 0.0000005 gm. of Ouabain for each gramme of body weight of frog. By maceration and percolation with Alcohol, Diluted Alcohol and water.

Dose, 0.1 mil (1½ ♏).

3. **Syrupus Scillæ.**—Syrup of Squill. Abv.—Syr. Scill. Vinegar of Squill, 450; Sugar, 800; water to 1000. By solution and straining.

Dose, 2 mils (30 ♏).

4. **Syrupus Scillæ Compositus.**—Compound Syrup of Squill. Abv.—Syr. Scill. Co. *Synonym.*—Hive Syrup. Fluidextract of Squill, 80; Fluidextract of Senega, 80; Antimony and Potassium Tartrate, 2; Distilled Water 10; Syrup to 1000.

Dose, 2 mils (30 ♏).

5. **Tinctura Scillæ.**—Tincture of Squill. Abv.—Tr. Scill. If assayed biologically the minimum lethal dose should not be greater than 0.0006 mil or the equivalent in Tincture of 0.0000005 gr. of Ouabain, for each gramme of body weight of frog. Squill, 100. By maceration and percolation with Alcohol and water.

Dose, 1 mil (15 ♏).

For the Therapeutics of Squill *see* p. 447.

SPARTEINÆ SULPHAS

SPARTEINE SULPHATE. Abv.—Spartein. Sulph. $C_{15}H_{26}N_2 \cdot H_2SO_4 + 5H_2O$ = 422.39. The sulphate of a liquid alkaloid Sparteine obtained from *Cystisus Scoparius* (Linné), Link (Fam. *Leguminosæ*).

SOURCE.—It is obtained by extracting the plant with water acidulated with Sulphuric Acid, concentrating, decomposing with Sodium Hydroxide, and distilling. The sulphate is prepared from the alkaloid by neutralization with Sulphuric Acid, and crystallization.

CHARACTERS.—Colorless, rhombohedral crystals, or a crystalline powder; odorless, and having a slightly saline and somewhat bitter taste. It is hygroscopic. *Solubility.*—In 1.1 parts of water and 3 of Alcohol; insoluble in Ether and Chloroform.

IMPURITIES.—Ammonium salts, aniline, and readily carbonizable organic matters.

Dose, 0.010 gm. = 10 milligm. (⅙ gr.).

For the Therapeutics of Sparteine Sulphate *see* p. 569.

CAMPHORA

CAMPHOR. Abv.—Camph. $C_{10}H_{16}O$ or $C_9H_{16}CO$=152.13. *Synonyms.*—Gum Camphor. Laurel Camphor. A ketone obtained from *Cinnamomum Camphora* (Linné) Nees et Ebermaier (Fam. *Lauraceæ*); it is dextro-rotatory. *Habitat.*—China and Japan.

SOURCE.—The branches and chipped wood are exposed to the vapors of boiling water, the volatilized Camphor is condensed, drained and pressed from the adherent volatile oil (Oil of Camphor), and subsequently refined by sublimation in vessels of glass or iron. Camphor is, at present, usually obtained by tapping the trees and collecting the exudation.

CHARACTERS.—White, translucent masses or granules, of a tough consistence readily pulverizable in the presence of a little Alcohol, Ether, or Chloroform; having a penetrating, characteristic odor, and a pungent aromatic taste. Sp. gr., 0.990 at 25°C. (77°F.). Burns with a smoky flame. *Solubility.*—Slightly soluble in water, but freely in Alcohol, Ether, Chloroform, Carbon Disulphide, Petroleum Benzin, or in fixed or volatile oils. When Camphor is triturated, in about molecular proportions, with Menthol, Thymol, Phenol, or Hydrated Chloral, liquefaction ensues.

COMPOSITION.—Camphor is an oxidation product of *Pinene* (*see* p. 216), and may also be derived from *Cymene* found in Oil of Caraway and Oil of Eucalyptus. The official camphor is called Laurel Camphor. Borneol, known as Borneo, Sumatra or Barus Camphor, often in commerce, substituted for the official camphor, which it closely resembles, is derived from *Dryobalanops Camphora*, and known from the official variety by sinking in water. It is $C_{10}H_{18}O$; that is to say, an alcohol. The common form of Borneo Camphor is dextro-rotatory, but lævo-rotatory and inactive varieties are known.

IMPURITY.—Chlorinated products.

Dose (by mouth), **0.2 gm. = 20 milligm. (3 gr.)**; (by hypodermatic) **0.1 gm. = 10 milligm. (1½ gr.).**

Camphor is contained in Linimentum Belladonnæ, Linimentum Chloroformi, Linimentum Saponis, and Tinctura Opii Camphorata.

Preparations

1. **Aqua Camphoræ.**—Camphor Water. Abv.—Aq. Camph. Camphor, 8; by trituration with Alcohol, 8; and Purified Talc, 15; addition of Distilled Water, and filtration to 1000.

Dose, 10 mils (2½ fl. dr.).

2. Linimentum Camphoræ:—Camphor Liniment. Abv.—Lin. Camph. *Synonym.*—Camphorated Oil. It yields not less than 19.5 per cent. nor more than 20.5 per cent. of Camphor. Camphor, 200; Cotton Seed Oil, 800. This is not intended for hypodermatic use.

3. Spiritus Camphoræ.—Spirit of Camphor. Abv.—Sp. Camph. It yields not less than 9.5 per cent. nor more than 10.5 per cent. of Camphor. Camphor, 100; by solution in Alcohol, 1000; and filtration.

Dose, 1 mil (15 ♏).

CAMPHORA MONOBROMATA.—Monobromated Camphor. Abv.—Camph. Monobrom. Ortho-monobrom-camphor, $C_{10}H_{15}BrO$ or $C_8H_{15}Br{\cdot}CO$ = 231.04.

SOURCE.—By heating Bromine and Camphor, at 77.7°C. (172°F.), solution in Benzin, and re-crystallization from hot Alcohol. $C_{10}H_{16}O+2Br=C_{10}H_{15}BrO+HBr$.

CHARACTERS.—Colorless, prismatic needles or scales or as a powder, having a mild but characteristic camphoraceous odor and taste; permanent in the air. It is decomposed by prolonged exposure to sunlight. *Solubility.*—Almost insoluble in water; soluble in 6.5 parts of Alcohol, in 1.6 parts of Ether, in 0.5 part of Chloroform.

IMPURITY.—Soluble bromide.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

For the Therapeutics of Camphor *see* p. 449.

CLASS II.—THE ACONITE GROUP, DECREASING THE FREQUENCY AND FORCE OF THE BEAT OF THE HEART

Aconite, Aconitine, Veratrum Viride, Veratrine

ACONITUM

ACONITE. Abv.—Aconit. *Synonyms.*—Monkshood. Wolfsbane. The dried tuberous roots of *Aconitum Napellus* Linné (Fam. *Ranunculaceæ*), without the presence or admixture of more than 5 per cent. of stems or other foreign matter. It should yield not less than 0.5 per cent. of the ether-soluble alkaloids of Aconite. If made into a fluidextract and assayed biologically the minimum lethal dose should not be greater than 0.00004 gm. for each gramme of body weight of guinea-pig. *Habitat.*—Mountainous districts of Europe, Asia, and Northwestern North America.

CHARACTERS.—More or less conical or fusiform, 4 to 10 cm. in length, 1 to 2 cm. in diameter at the crown; externally, dark-brown or grayish-brown, smooth or longitudinally wrinkled, the upper end with a bud, remains of bud-scales or stem scars, the other portions with numerous root-scars or short rootlets; fracture short, horny or somewhat mealy; internally, bark light or dark brown, 1 to 2 mm. in thickness, the cambium zone usually 5- to -8 angled with a small fibro-vascular bundle in each angle, pith whitish or light brown, from 2

to 7 mm. in diameter; odor very slight; taste sweetish, soon becoming acrid, and developing a tingling sensation, followed by numbness. *Resembling Aconite.*—Horseradish.

COMPOSITION.—The active principle is the very poisonous alkaloid *Aconitine* (*see* below). Two other alkaloids are present—*Aconine*, $C_{26}H_{39}O_{11}$, and *Benzaconine*. Other principles are, perhaps, *Pseudo-aconitine*, $C_{36}N_{39}NO_{11}$, or *Napelline*, $C_{17}H_{41}NO_3$, *Picro-aconitine*, $C_{31}H_{45}NO_{10}$, combined with Aconitic Acid, $H_3C_6H_3O_6$.

Dose, 0.03 gm. = 30 milligm. (½ gr.).

Preparations

1. **Extractum Aconiti.**—Extract of Aconite. Abv.—Ext. Aconit. It yields not less than 1.8 per cent. nor more than 2.2 per cent. of the ether-soluble alkaloids of Aconite. If assayed biologically, the minimum lethal dose should not be greater than 0.00001 Gm. for each gramme of body weight of guinea-pig. By maceration and percolation with Tartaric Acid and Alcohol, treatment with and decantation of Purified Petroleum Benzin, and evaporation.

Dose, 0.01 gm. = 10 milligm. (⅙ gr.).

2. **Fluidextractum Aconiti.**—Fluidextract of Aconite. It yields not less than 0.45 per cent. nor more than 0.55 per cent. of the ether-soluble alkaloids of Aconite. If assayed biologically the minimum lethal dose should not be greater than 0.0004 mil for each gramme of body weight of guinea-pig. By maceration and percolation with Alcohol and water, and evaporation.

Dose, 0.03 mil (½ ♏).

3. **Tinctura Aconiti.**—Tincture of Aconite. Abv.—Tr. Aconit. Aconite, 100; by maceration and percolation with Alcohol and Water. It yields one-tenth the amount of ether-soluble alkaloids and requires ten times the amount for a Minimum lethal dose for guinea-pig as the Fluidextract.

Dose, 0.3 mil (5 ♏).

It should be remembered that Fleming's Tincture of Aconite, which is found in the shops, is nearly seven times stronger than the official.

ACONITINA.—Aconitine. Abv.—Aconitin. $C_{34}H_{47}O_{11}N = 645.39$. An alkaloid obtained from Aconite.

SOURCE.—It is precipitated from an aqueous solution of an alcoholic extract of the powdered root by Ammonia, and then purified.

CHARACTERS.—Colorless or white rhombic tables or prisms; possessing no odor and permanent in the air. *The alkaloid itself should never be tasted, and its solutions only when largely diluted, and then with the utmost caution.* A drop of an aqueous solution (1 in 100,000) placed upon the tongue, produces a tingling and numbing sensation. *Solubility.*—In 28 parts of Alcohol, 65 of Ether, and 7 parts of Benzene; very slightly soluble in water.

IMPURITIES.—Pseudaconitine or atropine.

INCOMPATIBLES.—Those common to all alkaloids. *See* p. 122.

Dose, 0.00015 gm. = 0.15 milligm. (1/400 gr.).

For the Therapeutics of Aconite *see* p. 454.

VERATRUM VIRIDE

VERATRUM VIRIDE. Abv.—Verat. Vir. *Synonyms.*—Green Hellebore. American Hellebore. The dried rhizome and roots of *Veratrum viride* Aiton (Fam. *Liliaceæ*) without the presence or admixture of more than 5 per cent. of stems or other foreign matter. *Habitat.*—North America, in rich woods.

CHARACTERS.—Rhizome upright, obconical, usually cut longitudinally into 2 or 4 pieces, from 2 to 7 cm. in length and 1.5 to 3 cm. in diameter, externally light brown to dark brown or brownish-black, frequently bearing at the summit numerous, closely arranged, thin leaf-bases, otherwise rough and wrinkled, somewhat annulate from scars of bud-scales, and bearing in the outer portion numerous roots, the lower part more or less decayed; fracture hard and horny; internally yellowish or grayish-white, marked with numerous, irregular, fibro-vascular bundles, inodorous but sternutatory; taste acrid and bitter. Roots nearly cylindrical, from 3 to 8 cm. in length and from 1 to 3 mm. in diameter, externally light brown to yellowish-brown, deeply transversely wrinkled; fracture short, bark whitish, very thick, enclosing a porous central cylinder. *Resembling Veratrum.*—Valerian, Serpentaria, and Arnica, but Veratrum has thicker rootlets, and no odor.

COMPOSITION.—The chief constituents are—(1) *Veratrine* (*Cevadine*), $C_{32}H_{49}NO_9$, a powerful alkaloid which occurs in two forms, one crystalline and the other amorphous. (2) *Protoveratrine*, $C_{32}H_{51}NO_{11}$, almost rivaling Aconitine in its toxicity. (3) *Veratridine.* (4) *Jervine.* (5) *Pseudojervine*, an alkaloid. (6) *Rubijervine*, uncrystallizable and sternutatory. (7) An inactive resin.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Fluidextractum Veratri Viridis.**—Fluidextract of Veratrum Viride. Abv.—Fldext. Verat. Vir. By maceration and percolation with Alcohol and evaporation.

   Dose, 0.1 mil. (1½ ♏).

2. **Tinctura Veratri Viridis.**—Tincture of Veratrum Viride. Abv.—Tr. Verat. Vir. Veratrum Viride, 100; by maceration and percolation, with Alcohol to 1000.

   Dose, 0.5 mil (8 ♏).

It should be remembered that Norwood's Tincture of Veratrum, which is found in the shops is four and one-half times stronger than the official.

VERATRINA

VERATRINE.—Abv.—Veratrin. A mixture of alkaloids obtained from the seeds of *Asagræa officinalis* (Chamisso and Schlechtendal) Lindley (Fam. *Liliaceæ*). *Habitat.*—Mexico to Venezuela.

SOURCE.—(1) The seed is exhausted with Alcohol, and the Alcohol recovered by distillation. (2) The residuary liquid is diluted with water to precipitate the resins and filtered. (3) Ammonia is added to the filtrate when Veratrine is precipitated. (4) It is then re-dissolved, decolorized, and re-precipitated.

CHARACTERS.—A white or grayish-white, amorphous powder, odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane. *Great caution should be used in tasting it.* It is slightly hygroscopic. *Solubility.*—In 1760 parts of water, 2.8 of Alcohol, 4.2 of Ether and in 0.7 part of Chloroform at 25°C. (77°F.); insoluble in Petroleum Benzin.

IMPURITIES.—Various foreign alkaloids.

For the Therapeutics of Veratrum Viride and Veratrine *see* p. 461.

GROUP III.—Drugs Acting Chiefly on the Respiratory Organs.

Senega, Sanguinaria, Ipecac, Lobelia, Aspidosperma, Eriodictyon, Wild Cherry, Almond, Benzaldehyde.

SENEGA

SENEGA.—Abv.—Seneg. *Synonyms.*—Seneca Snakeroot. Senega Snakeroot. The dried roots of *Polygala Senega* Linné (Fam. *Polygalaceæ*), without the presence or admixture of more than 5 per cent. of stems or other foreign matter. *Habitat.*—United States, westward to Minnesota.

CHARACTERS.—Usually in broken pieces; when entire slenderly conical, more or less tortuous, from 3 to 15 cm. in length and 2 to 10 mm. in thickness, and bearing a few rootlets; crown knotty, with numerous buds and short stem-bases; externally brownish-yellow; the crown, rose-tinted, longitudinally wrinkled, frequently marked by a keel; fracture short, wood pale yellow, usually excentrically developed; odor peculiar, penetrating; taste sweetish, afterwards acrid. *Resembling Senega root.*—Arnica, Valerian, Serpentaria and Green Hellebore, but none of these have a keel.

COMPOSITION.—The active principle is *Senegin* ($C_{32}H_{54}O_{18}$). Also called *Saponin*, which is a colorless, amorphous glucoside, insoluble in Alcohol, but forming a soapy emulsion when mixed with boiling water, and is decomposed by Hydrochloric Acid into glucose and *Sapogenin*. It acts like *Digitonin* (*see* p. 136) and is found in many plants.

IMPURITIES.—Other roots are mixed with it.

Dose, 1 gm. (15 gr.).

Preparations

1. **Fluidextractum Senegæ.**—Fluidextract of Senega. Abv.—Fldext. Seneg. By maceration and percolation with Ammonia Water, Alcohol and water, and evaporation.

Dose, 1 mil (15 ♏).

2. Syrupus Scillæ Compositus.—*See* p. 138.

3. Syrupus Senegæ.—Syrup of Senega. Abv.—Syr. Seneg. Fluidextract of Senega, 200; Syrup, 800.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Senega *see* p. 607.

SANGUINARIA

SANGUINARIA. Abv.—Sanguin. *Synonym.*—Bloodroot. The dried rhizomes and roots of *Sanguinaria canadensis* Linné (Fam. *Papaveraceæ*). *Habitat*—North America in rich woods.

CHARACTERS.—Of horizontal growth, occasionally branching, more or less cylindrical, somewhat flattened, 2 to 7 cm. in length, 5 to 15 mm. in diameter; externally dark brown, slightly annulate, with a few stem-scars on the upper surface and numerous more or less broken filiform roots and root-scars on the lower surface; fracture short and somewhat waxy, brownish-red, occasionally yellowish-white, with numerous small, circular yellowish fibro-vascular bundles within about 1 mm. of the epidermis, pith very large; odor slight; taste persistently acrid and bitter.

COMPOSITION.—Its chief constituents are—(1) *Sanguinarine*, $C_{20}H_{15}NO_4$, a white substance, soluble in Alcohol. (2) *Chelerythrine*, $C_{20}H_{15}NO_4$. (3) *Protopine*, $C_{22}H_{21}NO_5$ also present in Opium (*see* p. 114). (4) *Homochelidonine*, $C_{22}H_{21}NO_4$. (5) Resins. (6) Citric and Malic Acids.

Dose, 0.125 gm. (2 gr.).

Preparation

Tinctura Sanguinariæ.—Tincture of Sanguinaria. Abv.—Tr. Sanguin. Sanguinaria, 100; by maceration with Hydrochloric Acid, 10; Alcohol and water, and percolation to 1000.

Dose, 1 mil (15 ♏).

For the Therapeutics of Sanguinaria *see* p. 609.

IPECACUANHA

IPECAC. The dried root of *Cephaëlis Ipecacuanha* (Brotero) A. Richard (Fam. *Rubiaceæ*), known in commerce as Rio, Brazilian or Para Ipecac, or the corresponding portion of *Cephaëlis acuminata* Karsten, known in commerce as Cartagena Ipecac, without the presence or admixture of more than 5 per cent. of stems or other foreign matter and yielding not less than 1.75 per cent. of the ether-soluble alkaloids of Ipecac. *Habitat.*—Brazil to Bolivia and New Granada, in damp forests cultivated in India.

CHARACTERS. *Cephaëlis Ipecacuanha.*—In cylindrical pieces, curved and sharply flexuous, occasionally branched, from 3 to 15 cm. in length and from 2.4

to 4 mm. in thickness; externally dark brown, closely annulated, with thickened, incomplete rings, and usually exhibiting transverse fissures with vertical sides; fracture of bark short, of wood tough, bark very thick, light brown, easily separable from the yellowish-white wood; odor very slight, distinctive, the dust sternutatory; taste bitter and nauseous, somewhat acrid.

Stems cylindrical, attaining a length of 10 cm. and a thickness of 2 mm., dark brown, finely longitudinally wrinkled and with a few eliptical scars.

Cephaëlis acuminata.—Cylindrical or slenderly fusiform, more or less tortuous, from 3 to 12 cm. in length and from 4 to 6.5 mm. in thickness; internally grayish-brown, the annulations usually not so numerous as in Rio Ipecac, occasionally transversely fissured, and with circular scars of roots; bark 2 mm. in thickness, dark brown, smooth, somewhat horny and easily separable from the light brown wood.

Stems attaining a length of 10 cm. and a thickness of from 2 to 3 mm., cylindrical, sometimes zigzag, due to prominent nodes with their eliptical stem-scars, grayish or dark brown and longitudinally wrinkled; bark thin.

COMPOSITION.—The chief constituents are—(1) *Emetine*, $C_{30}H_{44}N_2O_4$, from 1 to 2 per cent., an uncrystallizable alkaloid. It is colorless (turns yellow on keeping), odorless, bitter, and soluble in Alcohol, Ether and Chloroform, slightly soluble in water, not in caustic alkali. (2) *Cephaëline*, $C_{28}H_{38}N_2O_4$, an amorphous, bitter alkaloid, colorless (turns yellow on keeping), soluble in caustic alkali, less soluble in Ether than Emetine, but freely in Alcohol and Chloroform. (3) A third alkaloid in minute quantities. (4) A mixture called *Cephaëlic* or *Ipecacuanhic Acid.* (5) Tannic Acid, Volatile Oil, Starch, Gum. The proportion of each alkaloid varies in different specimens of the root, but as a rule there is twice as much *Emetine* as *Cephaëline.*

IMPURITIES.—Hemidesmus, which is cracked, not annulated; almond powder, occasionally found mixed with powdered ipecacuanha root, gives the odor of hydrocyanic acid when moistened.

Dose, (emetic) 1 gm. (15 gr.).

Preparations

1. **Fluidextractum Ipecacuanhæ.**—Fluidextract of Ipecac. Abv.—Fldext. Ipecac. It contains not less than 1.8 per cent. nor more than 2.2 per cent. of the ether-soluble alkaloids of Ipecac. By maceration and percolation with Diluted Hydrochloric Acid, Alcohol and water.

Dose (expectorant) 0.05 mil (1 ♏).

Fluidextract of Ipecacuanha is used in Mistura Rhei et Sodæ.

2. **Pulvis Ipecacuanhæ et Opii.**—*See* p. 115.

3. **Syrupus Ipecacuanhæ.**—Syrup of Ipecac. Abv.—Syr. Ipecac. Fluidextract of Ipecac, 70; Acetic Acid, 10; Glycerin, 100; Sugar, 700; Water to 1000.

Dose (expectorant), 1 mil (15 ♏); (emetic) 15 mils (4 fl. dr.).

EMETINÆ HYDROCHLORIDUM.—Emetine Hydrochloride. Abv.—Emet. Hydrochl. The Hydrochloride ($C_{30}H_{44}O_4N_2 \cdot 2HCl = 569.31$) of the al-

kaloid Emetine, obtained from Ipecac. It contains variable amounts of water of crystallization.

CHARACTERS.—A white or very slightly yellowish crystalline powder, without odor. On exposure to the light it gradually darkens. *Solubility.*—Freely soluble in water or Alcohol.

IMPURITIES.—Cephaëline, readily carbonizable impurities.

Dose (hypodermatic), **0.02 = 20 milligm. (⅓ gr.).**

For the Therapeutics of Ipecac and its Alkaloid *see* p. 603.

LOBELIA

LOBELIA. Abv.—Lobel. *Synonym.*—Indian Tobacco. The dried leaves and flowering tops of *Lobelia inflata* Linné (Fam. *Campanulaceæ*), without the presence or admixture of more than 10 per cent. of stems or other foreign matter. *Habitat.*—North America, in the fields and open woods.

CHARACTERS.—Stems cylindrical, coarsely and irregularly furrowed, yellowish-green, occasionally purplish, and with numerous spreading hairs; leaves alternate, sessile or narrowing into a short petiole, usually more or less broken; when entire, laminæ ovate or oblong, 2 to 9 cm. in length; obtusely toothed or irregularly serrate-denticulate, each tooth with a yellowish-brown, gland-like apex; pale green with scattered, bristly hairs; flowers blue in long loose racemes with short pedicels, calyx-tube ovoid, with 5 subulate teeth, corolla tubular, from 3 to 4 mm. in length, 5-parted, the upper 2-lobed portion cleft nearly to the bases; stamens with anthers united above into a curved tube enclosing the bifid stigmas; capsules ovoid or ellipsoidal, from 5 to 8 mm. in length, light brown wholly inferior and enclosing numerous brownish, oblong and coarsely reticulate seeds; odor slight; taste strongly acrid.

COMPOSITION.—The chief constituents are—(1) *Lobeline*, an alkaloid, a yellowish, oily liquid of pungent taste, having an odor resembling that of tobacco. (2) *Lobelacrin* (probably *Lobeline Lobelate*). (3) Lobelic Acid.

INCOMPATIBLES.—Caustic alkalies, as they decompose the alkaloid.

Dose, 0.15 gm. (2½ gr.).

Preparations

1. **Fluidextractum Lobeliæ.**—Fluidextract of Lobelia. Abv.—Fldext. Lobel. By maceration and percolation with Acetic Acid and Water, and evaporation.

   Dose, 0.15 mil. (2½ ♏).

2. **Tinctura Lobeliæ.**—Tincture of Lobelia. Abv.—Tr. Lobel. Lobelia, 100; by percolation with Diluted Alcohol to 1000.

   Dose (expectorant), **1 mil. (15 ♏).**

For the Therapeutics of Lobelia *see* p. 611.

ASPIDOSPERMA

ASPIDOSPERMA. Abv.—Aspidosp. *Synonym.*—Quebracho. The dried bark of *Aspidosperma Quebrachoblanco* Schlechtendal (Fam. *Apocynaceæ*),

without the presence or admixture of more than 2 per cent. of wood or other foreign matter. *Habitat.*—Argentina.

CHARACTERS.—In irregular chips or in longitudinal pieces attaining a length of 14 cm. and a thickness of 35 mm.; outer corky layer from 3 to 25 mm. in thickness, brownish-gray or reddish-brown and deeply furrowed, frequently somewhat reticulate with longitudinal and shallow transverse fissures, the crevices being occasionally lined with the mycelia of a grayish mould; outer surface of the bark, from which the cork has been separated, light brown or reddish-brown and usually more or less roughened; inner surface occasionally with adhering wood, otherwise light yellowish-brown to light reddish-brown, longitudinally finely striate and finely porous; fracture short-fibrous with projecting bast-fibers; nearly inodorous, taste bitter and slightly aromatic.

COMPOSITION.—It contains at least six alkaloids; *Aspidospermine, Aspidospermatine, Aspidosamine, Quebrachine, Hypoquebrachine* and *Quebrachamine.* The Aspidospermine of commerce (amorphous Aspidospermine) is not a pure principle, but probably contains all the alkaloids of the bark; but it may consist chiefly of Aspidosamine.

Dose, 4 gm. (60 gr.).

Preparation

Fluidextractum Aspidospermatis.—Fluidextract of Aspidosperma. Abv.—Fldext. Aspidosp. *Synonym.*—Fluidextract of Quebracho. By percolation with Glycerin, Alcohol and Water.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Aspidosperma *see* p. 613.

ERIODICTYON

ERIODICTYON. Abv.—Eriodict. *Synonyms.*—Yerba Santa. Mountain Balm. The dried leaves of *Eriodictyon californicum* (Hooker and Arnott) Greene (Fam. *Hydrophyllaceæ*). *Habitat.*—California.

CHARACTERS.—Usually in fragments; when entire, laminæ lanceolate, 5 to 15 cm. in length and 1 to 3 cm. in breadth; summits acute; bases slightly tapering into short, petioles; margins irregularly serrate or crenate-dentate; upper surface yellowish-green, covered with a more or less glistening resin; under surface grayish or yellowish-white, conspicuously reticulate with greenish-yellow veins; minutely tomentose between the reticulations; thick, brittle; odor aromatic; taste balsamic, bitter, becoming sweetish.

COMPOSITION.—The chief constituents are—(1) Volatile Oil. (2) Resin, greenish-yellow, acrid, containing *Ericolin*, $C_{34}H_{56}O_{21}$. (3) Tannic acid, 8 per cent.

Dose, 1 gm. (15 gr.).

Preparation

Fluidextractum Eriodictyi.—Fluidextract of Eriodictyon. Abv.—Fldext. Eriodict. By maceration and percolation with Alcohol and Water, and evaporation.

Dose, 1 mil. (15 ♏).

For the Therapeutics of Eriodictyon *see* p. 610.

PRUNUS VIRGINIANA

WILD CHERRY.—The stem-bark of *Prunus serotina* Ehrhart (*Prunus Virginiana* Miller) (Fam. *Rosaceæ*), collected in autumn and carefully dried. *Habitat.*—North America, westward to Minnesota and Louisiana; in woods.

CHARACTERS.—Usually in transversely curved pieces from 2.5 to 8 cm. in length, and from 0.5 to 4 mm. in thickness; outer surfaces light brown or greenish-brown, smooth, except for numerous lenticels from 3 to 4 mm. in length; inner surfaces light brown, longitudinally striate, and occasionally fissured; fracture short, granular; odor distinct, bitter, almond-like when macerated in water; taste astringent, aromatic, and agreeably bitter.

COMPOSITION.—(1) *Amygdalin*, which yields with water, glucose, Hydrocyanic Acid (*see* p. 65), and the Oil of Bitter Almond. (2) *Emulsin*, probably identical with emulsin of Bitter Almond. The action of this ferment is destroyed at boiling temperature. (3) Tannic Acid.

Dose, 2 gm. (30 gr.).

Preparation

Syrupus Pruni Virginianæ.—Syrup of Wild Cherry. Abv.—Syr. Prun. Virg. Wild Cherry, 150; Sugar, 800; Glycerin, 50; Water to 1000. By maceration and percolation.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Wild Cherry *see* p. 601.

AMYGDALA

AMYGDALA DULCIS. Sweet Almond. Abv.—Amygd. Dulc. *Synonym.*—Jordan Almond. The ripe seeds of *Prunus Amygdalus dulcis* De Candolle (Fam. *Rosaceæ*). *Habitat.*—Western Asia; naturalized in the Mediterranean basin; cultivated.

CHARACTERS.—Ovate or oblong lanceolate, 17 to 25 mm. in length, 10 to 13 mm. in breadth and 4 to 7 mm. in thickness; seed-coat light brown with numerous parallel veins, thin and easily removed on soaking the seed in water; embryo straight, white and with two plano-convex cotyledons; taste, bland, sweet.

COMPOSITION.—The chief constituents are—(1) *Oleum Amygdalæ Expressum* (*see* below), 56 per cent., a fixed oil. (2) *Emulsin*, and other albuminous bodies.

IMPURITY.—The bitter almond, giving an odor of Hydrocyanic Acid when rubbed with water.

Preparation

Emulsum Amygdalæ.—Emulsion of Almond. Abv.—Emul. Amygd. *Synonym.*—Milk of Almond. Sweet Almond, 60; Acacia, 10; Sugar, 30; Water, to make 1000.

OLEUM AMYGDALÆ EXPRESSUM.—Expressed Oil of Almond. Abv.—Ol. Amygd. Exp.

SOURCE.—A fixed oil obtained from the kernels of varieties of *Prunus Amygdalus* Stokes (Fam. *Rosaceæ*).

CHARACTERS.—A clear, pale straw-colored or colorless, oily liquid, almost inodorous, and having a bland taste. Sp. gr., 0.910 to 0.915. *Solubility.*—Slightly in Alcohol; miscible with Ether, Chloroform, Benzene or Petroleum Benzin.

IMPURITIES.—Olive or lard oil, oils of apricot or peach kernels, arachis, Sesame or cotton seed oil, paraffin and various foreign oils.

Expressed Oil of Almond is contained in Emulsum Olei Terebinthinæ and Unguentum Aquæ Rosæ.

OLEUM AMYGDALÆ AMARÆ.—Oil of Bitter Almond. Abv.—Ol. Amygd. Amar. A volatile oil obtained by maceration and distillation from the ripe kernels of *Prunus Amygdalus Amara* De Candole (Fam. *Rosaceæ*), and from other kernels containing Amygdalin. It yields not less than 85 per cent. of Benzaldehyde (C_7H_6O) and not less than 2 per cent. nor more than 4 per cent. of Hydrocyanic Acid. *This oil is intended for medicinal use; it must not be used for flavoring foods.* If it shows crystals of Benzoic Acid it must not be dispensed.

SOURCE.—By maceration with water, and distillation. Hydrocyanic Acid is derived from Oil of Bitter Almond by shaking with Milk of Lime and a small quantity of solution of Iron Sulphate. After standing for several days the Hydrocyanic Acid is converted into Ferric Ferrocyanide and the mixture is then distilled with water.

CHARACTERS.—A clear, colorless or yellow, strongly refractive liquid, having the characteristic odor and taste of Benzaldehyde. Sp. gr., 1.038 to 1.060 at 25°C (77°F.). *Solubility.*—Slightly in water; soluble in Alcohol or Ether in all proportions; and dissolves in 2 volumes of 70 per cent. of Alcohol.

IMPURITIES.—Chlorinated products, nitrobenzene and artificial oils.

Dose, 0.3 mil (½ ♏).

Preparations

1. **Aqua Amygdalæ Amaræ.**—Bitter Almond water. Abv.—Aq. Amyg. Amar. Oil of Bitter Almond, 1; Distilled Water, to 1000. By solution and filtration. It contains a mere trace of Hydrocyanic Acid.

Dose, 4 mils (1 fl. dr.).

2. **Spiritus Amygdalæ Amaræ.**—Spirit of Bitter Almond. Abv.—Sp. Amygd. Amar. Oil of Bitter Almond, 10; Alcohol, 800; Distilled Water, to 1000. *It is intended for medicinal use; it must not be used for flavoring food.*

Dose, 0.5 mil (8 ♏).

BENZALDEHYDUM

BENZALDEHYDE. Abv.—Benzaldehyd. C_7H_6O or $C_6H_5 \cdot CHO = 106.05$. *Synonym.*—Bnezoic Aldehyde. An aldehyde, produced synthetically, or obtained from Oil of Bitter Almond, and containing not less than 85 per cent. of Benzaldehyde.

SOURCE.—From toluene by substitution into Benzyl Chloride and decomposition with Barium Nitrate and Carbon Dioxide.

CHARACTERS.—A colorless, or yellowish, strongly refractive liquid, having a bitter-almond-like odor and a burning, aromatic taste. Sp. gr., about 1.045. *Solubility.*—Slightly in water; miscible with Alcohol, Ether or fixed or volatile oils.

IMPURITIES.—Hydrocyanic acid and chlorinated products. Exposed to oxygen, it readily changes into Benzoic Acid.

Dose, 0.03 mil (½ ♏).

For the Therapeutics of Almond *see* p. 542.

GROUP IV.—Drugs having Antiperiodic, Antipyretic and Antiseptic Properties

Cinchona, Quinine, Salicin, Salicylic Acid, Methyl Salicylate, Phenyl Salicylate, Creosote, Creosote Carbonate, Guaiacol, Guaiacol Carbonate.

CINCHONA

CINCHONA. Abv.—Cinch. *Synonyms.*—Yellow Peruvian Bark. Calisaya Bark. The dried bark of *Cinchona Ledgeriana* Moens, *Cinchona Calisaya* Weddell and of hybrids of these with other species of *Cinchona* (Fam. *Rubiacæ*) yielding not less than 5 per cent. of the alkaloids of Cinchona. *Habitat.*—South America, on the Eastern slope of the central chain of the Andes, thence spreading northward into Colombia; cultivated in Java, India, Jamaica, and other countries; to a limited extent also in South America.

CHARACTERS.—In quills or curved pieces, of variable length, bark from 3 to 5 mm. in thickness or in small broken fragments or in transversely curved pieces from 3 to 7 mm. in thickness; externally gray, rarely brownish-gray, with numerous intersecting transverse and longitudinal fissures, having nearly vertical sides, and usually with patches of foliaceous lichens with their small, brownish-black apothecia; when the outer bark is absent, the color externally is cinnamon-brown; inner surface light cinnamon-brown, finely striate; fracture of the outer bark short and granular, of the inner bark finely splintery; odor faintly aromatic; taste very bitter and somewhat astringent.

COMPOSITION.—The principal constituents of Cinchona Bark are: (1) *Quinine.*—An alkaloid (*see* p. 152) gives a green color with Chlorine water and Ammonia; turns the plane of polarization to the left; solutions of its salts are fluorescent. (2) *Quinidine.*—An alkaloid, $C_{20}H_{24}O_2N_2$, isomeric with Quinine, differing from it only in crystallizing in prisms, turning the plane of polarization to the right, and not being soluble in Ammonia except in excess. (3) *Cinchonine.*—An alkaloid, $C_{19}H_{22}ON_2$. Colorless prisms, inodorous, bitter. No green color with Chlorine Water and Ammonia. Turns the plane of polarization to the right; not fluorescent. (4) *Cinchonidine.*—An alkaloid, $C_{19}H_{22}ON_2$, isomeric with Cinchonine, differing from it in turning the plane of polarization to the left, being sparingly soluble in Ether, and being slightly fluorescent. (5) *Quinamine.*—An alkaloid $C_{19}H_{24}N_2O_2$; not important. (6) *Kinic or Quinic Acid.*—$C_7H_{12}O_6$. Large, colorless prisms. It and its salts are soluble in water, and thus Quinine may be

given subcutaneously as Quinine Quinate. This acid is found in the Coffee Bean and other plants. It is allied to Benzoic Acid, and appears in the urine as Hippuric Acid. (7) *Kinovin or Quinovin.*—A glucoside, $C_{30}H_{48}O_8$, which easily decomposes into glucose and *Kinovic or Quinovic* Acid, $C_{22}H_{48}O_6$. (8) *Cinchotannic Acid.*—2 to 4 per cent., the astringent principle of Cinchona Bark. It differs from Tannic Acid in becoming green with ferric salts and is easily oxidized to (9) *Cinchona Red.*—The coloring matter of the bark, almost insoluble in water. (10) *A Volatile Oil.*—In minute quantities giving Cinchona Bark its odor.

Remijia Bark yields, in addition, Homoquinine, which is a compound of Quinine and another alkaloid, Cupreine, $C_{19}H_{22}O_2N_2$.

IMPURITIES.—Inferior barks, known by their not yielding the full strength of Quinine and Cinchonine. The true yellow Cinchona Bark must not be confounded with other Cinchona barks of a similar color, but having the bast fibres in bundles or raised rows, and breaking with a splintery or coarsely fibrous fracture.

INCOMPATIBLES.—Alkalies and their carbonates, alkaloidal precipitants (*see* p. 122), ammonia, gelatin, lime water, metallic salts.

Dose, 1 gm. (15 gr.).

Preparations

1. **Fluidextractum Cinchonæ.**—Fluidextract of Cinchona. Abv.—Fldext. Cinch. It yields not less than 4 per cent. nor more than 5 per cent. of the alkaloids of Cinchona. By maceration and percolation with Alcohol, Glycerin and water, and evaporation, addition of Alcohol.

Dose, 1 mil (15 ♏).

2. **Tinctura Cinchonæ.**—Tincture of Cinchona. Abv.—Tr. Cinch. Cinchona. It yields not less than 0.8 per cent. nor more than 1 per cent. of the alkaloids of Cinchona. By maceration and percolation with Glycerin, Alcohol and water to 1000.

Dose, 4 mils (1 fl. dr.).

CINCHONA RUBRA

RED CINCHONA. Abv.—Cinch. Rub. *Synonym.*—Red Peruvian Bark. The dried bark of *Cinchona succirubra* Pavon (Fam. *Rubiaceæ*), or of its hybrids, yielding not less than 5 per cent. of the alkaloids of Red Cinchona. *Habitat.*—Ecuador, west of Chimborazo.

CHARACTERS.—In quills or curved pieces of variable length, the bark from 2 to 4 mm. in thickness, or in small broken fragments, or in transversely curved pieces from 3 to 7 mm. in thickness; externally gray, grayish-brown, or reddish-brown, more or less rough from corky protuberances occasionally with transverse fissures which are rarely numerous or much intersected, and having their sides sloping and with occasional patches of foliaceous lichens; inner surface reddish or orange-brown, distinctly striate; fracture short and granular in the outer bark, shortly and rather coarsely splintery in the inner bark; odor slight; taste very bitter and astringent.

CONSTITUENTS.—*See* Cinchona.

Dose, 1 gm. (15 gr.).

Preparation

Tinctura Cinchonæ Composita.—Compound Tincture of Cinchona. Abv.—Tr. Cinch. Co. It yields not less than 0.4 per cent. nor more than 0.5 per cent. of the alkaloids of Cinchona. Red Cinchona, 100; Bitter Orange Peel, 80; Serpentaria, 20. By maceration and percolation with Alcohol, Glycerin and water to 1000.

Dose, 4 mils. (1 fl. dr.).

The name "Huxham's Tincture" is often incorrectly applied to this preparation.

1. QUININA.—Quinine. Abv.—Quin. $C_{20}H_{24}O_2N_2+3H_2O=378.26$. An alkaloid obtained from the bark of various species of Cinchona.

SOURCE.—By adding to a solution of the Sulphate a sufficient quantity of Ammonia Water to precipitate the Alkaloid.

CHARACTERS.—A white, micro-crystalline powder; odorless, having a bitter taste, developing rather slowly but intense and persistent; efflorescent in dry air. *Solubility.*—Soluble in 1560 parts of water, 0.8 part of Alcohol, 1.9 of Ether, 1.1 of Chloroform; in 800 parts of water at 25°C. (77°F.). It is soluble in diluted acids.

IMPURITIES.—Other alkaloids, cinchonine, cinchonidine and morphine; ammonium salts; readily carbonizable organic impurities; lime, chalk, magnesia, starch and other white powders; salicin, detected by its giving a blood-red color with sulphuric acid.

INCOMPATIBLES.—Those common to all alkaloids, *see* p. 122.

Dose (tonic), **0.100 gm. = 100 milligm. (1½ gr.)**; (anti-malarial) **at least 1 gm. (15 gr.) daily.**

Quinine is used to prepare Ferri et Quininæ Citras.

2. QUININÆ SULPHAS.—Quinine Sulphate. Abv.—Quin. Sulph. $(C_{20}H_{24}O_2N_2)_2H_2SO_4+7H_2O=872.62$. The Sulphate of the alkaloid *Quinine*.

SOURCE.—By boiling Cinchona in water acidulated with Hydrochloric Acid and straining. Add Lime to the decoction, and wash the precipitate. Digest in boiling Alcohol, and distil off the Alcohol. Dissolve the residue in Distilled Water and Sulphuric Acid, boil with Animal Charcoal, filter and set aside to crystallize.

CHARACTERS.—White, silky, light, flexible, glistening crystals, making a very light and easily compressible mass, or hard prismatic, monoclinic needles; odorless, and having a persistent, very bitter taste. It effloresces rapidly when it is exposed to dry air, and then becomes lusterless; when exposed to light it acquires a brownish tint. *Solubility.*—In 725 parts of water, 107 of Alcohol, and 30 of Glycerin; slightly soluble in Chloroform and in Ether. It is freely soluble in a mixture of 7 volumes of Chloroform and 4 volumes of Dehydrated Alcohol. Diluted acids increase its solubility in water.

Dose (tonic), **0.100 gm. = 100 milligm. (1½ gr.)**; (anti-malarial) **at least 1 gm. (15 gr.) daily.**

3. QUININÆ BISULPHAS.—Quinine Bisulphate. Abv.—Quin. Bisulph. $C_{20}H_{24}O_2N_2 \cdot H_2SO_4+7H_2O=548.41$. The acid Sulphate of the alkaloid Quinine.

SOURCE.—By suspending Quinine Sulphate in water, adding Sulphuric Acid, filtering and crystallizing.

CHARACTERS.—Colorless, transparent or whitish, orthorhombic crystals or small needles; odorless, and having a very bitter taste. It effloresces on exposure to the air, and turns yellow on exposure to light. *Solubility.*—In 9 parts of water, in 23 parts of Alcohol, in 15 of Glycerin, 625 of Chloroform and in 2500 of Ether at 25°C.(77°F.).

IMPURITIES.—Morphine and organic impurities.

Dose (tonic), 0.100 gm. = 100 milligm. (1½ gr.),; (anti-malarial) at least 1 gm. (15 gr.) daily.

4. QUININÆ HYDROBROMIDUM.—Quinine Hydrobromide. Abv.—Quin. Hydrobrom. $C_{20}H_{24}O_2N_2 \cdot HBr + H_2O = 423.16$. The Hydrobromide of the alkaloid Quinine.

SOURCE.—By suspending Quinine Sulphate in Water, adding Barium Bromide in solution, filtering, evaporating, and crystallizing.

CHARACTERS.—White, light, silky needles; odorless, and having a very bitter taste; effloresces on exposure to the air. *Solubility.*—In 40 parts of water, 0.9 part of Alcohol, 23 parts of Ether, and 7 parts of Glycerin; in 3.2 parts of water at 80°C. (176°F.); in 0.6 part of Chloroform.

IMPURITIES.—Barium, sulphates, readily carbonizable impurities.

Dose (tonic), 0.100 gm. = 100 milligm. (1½ gr.); (anti-malarial) at least 1 gm. (15 gr.). daily.

5. QUININÆ HYDROCHLORIDUM.—Quinine Hydrochloride. Abv.—Quin. Hydrochlor. $C_{20}H_{24}O_2N_2 \cdot HCl + 2H_2O = 396.71$. The Hydrochloride of the alkaloid Quinine.

SOURCE.—By treating the alkaloid Quinine with diluted Hydrochloric Acid, and crystallization.

CHARACTERS.—White, silky, glistening needles; odorless, and having a very bitter taste; effloresces when exposed to warm air. *Solubility.*—In 18 parts of water, 0.8 part of Alcohol, 0.7 part of Chloroform, 340 parts of Ether and 7 of Glycerin; in 0.4 part of water at 25°C. (77°F.).

Dose (tonic), 0.1 gm. = 100 milligm. (1½ gr.); (anti-malarial) at least 1 gm. (15 gr.) daily.

6. QUININÆ DIHYDROCHLORICUM.—Quinine Dihydrochloride. Abv.—Quin. Dihydrochl. $C_{20}H_{24}O_2N_2 \cdot 2HCl = 397.15$. The Dihydrochloride of the alkaloid Quinine.

SOURCE.—By suspending Quinine Hydrochloride in water, adding Hydrochloric Acid, filtering and crystallizing.

CHARACTERS.—A white powder, odorless and having a very bitter taste. *Solubility.*—In about 0.6 part of water and in 12 parts of Alcohol at 25°C. (77°F.); it is slightly soluble in Chloroform and very slightly soluble in Ether.

Dose (tonic), 0.100 gm. = 100 milligm. (1½ gr.); (anti-malarial) at least 1 gm. (15 gr.) daily.

7. QUININÆ ET UREÆ HYDROCHLORIDUM.—Quinine and Urea Hydrochloride. Abv.—Quin. et Urea. Hydrochl. $C_{20}H_{24}O_2N_2 \cdot HCl \cdot CO(NH_2)_2 \cdot HCl +$

$5H_2O = 547.28$. A compound of the Hydrochlorides of Quinine and Urea which contains not less than 58 per cent. of anhydrous Quinine.

SOURCE.—By dissolving Quinine Hydrochloride in diluted Hydrochloric Acid, adding to the solution Urea, filtration and crystallization.

CHARACTERS.—Colorless, translucent prisms or as a white, granular powder; odorless and having a very bitter taste; permanent in the air. *Solubility.*—In 0.9 part of water and in 2.4 parts of Alcohol.

IMPURITIES.—Ammonium compounds and readily carbonizable water.

Dose, hypodermatic (one dose daily), **1 gm. (15 gr.).**

8. QUININÆ SALICYLAS.—Quinine Salicylate. Abv.—Quin. Salicyl. $C_{20}H_{24}O_2N_2C_7H_6O_3 + H_2O = 420.28$. The Salicylate of the alkaloid Quinine.

SOURCE.—It may be obtained by double decomposition between solutions of Quinine Hydrochloride and Ammonium Salicylate or by saturating an alcoholic solution of Quinine with an alcoholic solution of Salicylic Acid.

CHARACTERS.—Colorless needles, having a bitter taste; permanent in the air, but on keeping, readily assume a pinkish color. *Solubility.*—In 77 parts of water, 14 of Alcohol, 160 of Ether, 25 of Chloroform, and 13 parts of Glycerin; slightly soluble in water at 25°C. (77°F.).

Dose (tonic), **0.100 gm. (1½ gr.)**; (anti-malarial) **at least 1 gm. (15 gr.) daily.**

9. QUININÆ TANNAS.—Quinine Tannate. Abv.—Quin. Tann. A compound of the alkaloid Quinine with Tannic Acid, of somewhat varying composition and containing not less than 30 per cent. nor more than 35 per cent. of anhydrous Quinine.

SOURCE.—By precipitating a solution of Quinine Sulphate in Sulphuric Acid and water with a solution of Tannic Acid with Sodium Bicarbonate in water, and filtration.

CHARACTERS.—A pale yellow or yellowish-white, amorphous powder, odorless and tasteless, or having not more than a slightly bitter and astringent taste. *Solubility.*—Slightly in water, Chloroform, or Ether; somewhat more soluble in Ether.

IMPURITIES.—Chlorides, sulphates and uncombined alkaloids.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

10. CINCHONINÆ SULPHAS.—Cinchonine Sulphate. Abv.—Cinchonin. Sulph. $(C_{19}H_{22}ON_2)_2 \cdot H_2SO_4 + 2H_2O = 722.51$. The Sulphate of an alkaloid obtained from the bark of several species of Cinchona.

SOURCE.—Obtained from the mother liquors after the crystallization of the Quinine, Quinidine, and Cinchonidine Sulphates by further concentration, precipitating the alkaloids by Caustic Soda, washing with Alcohol till free from other alkaloids, dissolving in Sulphuric Acid, purifying with animal charcoal, and crystallizing.

CHARACTERS.—White, lustrous prismatic crystals; odorless, and having a very bitter taste; permanent in the air. *Solubility.*—In 60 parts of water, 12.5 of Alcohol, 47 of Chloroform, and 3230 of Ether at 25°C. (77°F.); in 33 parts of water at 80°C. (176°F.) and 7 of Alcohol at 60°C. (140°F.).

IMPURITIES.—Quinine or Cinchonidine Sulphate, and readily carbonizable organic impurities.

Dose, 0.150 gm. = 150 milligm. (2½ gr.).

11. CINCHONIDINÆ SULPHAS.—Cinchonidine Sulphate. Abv.—Cinchonid. Sulph. $(C_{19}H_{23}ON_2 \cdot H_2SO_4 + 3H_2O = 740.53$. The Sulphate of an alkaloid obtained from the bark of several species of Cinchona.

SOURCE.—Obtained from the mother liquors after the crystallization of Quinine Sulphate by further concentration, purifying by crystallization from Alcohol, and finally from hot water.

CHARACTERS.—White, silky, glistening needles or prisms; odorless, and having a very bitter taste. *Solubility.*—In 65 parts of water and 620 of Chloroform, 25°C. (77°F.) also in 22 parts of water at 80°C. (176°F.), and 41 of Alcohol at 60°C. (140°F.). The presence of Sulphates of other Cinchona Alkaloids increases its solubility in Ether and Chloroform.

IMPURITIES.—Cinchonine or quinidine sulphate and readily carbonizable impurities.

Dose, 0.150 gm. = 150 milligm. (2½ gr.).

Warburg's tincture (Tinctura Antiperiodica) has a very high reputation in India for malaria. The published formula states that it is a proof-spirit tincture, containing Quinine Sulphate, 80; Socotrine Aloes, 100; Opium, 1; Rhubarb, 32; Camphor, 8; with Angelica, Elecampane, Saffron, Fennel, Gentian, Zedoary, Cubeb, Myrrh, and Agaric, as aromatics, with menstruum to 4000. This contains about 9½ gr. (0.60 gm.) of Quinine Sulphate to the ounce (30 mils) of menstruum. Dose, 4 to 15 mils; (1 to 4 fl. dr.). It is often directed to be made without the Aloes.

For the Therapeutics of Cinchona and its Alkaloids, *see* p. 346.

SALICINUM

SALICIN. $C_{13}H_{18}O_7 = 286.14$. *Synonym.*—Willow. A glucoside obtained from several species of *Salix* and *Populus* (Fam. *Salicaceæ*). *Habitat.*—Europe, naturalized in North America; cultivated.

SOURCE.—(1) Make a strong decoction of willow bark. (2) Remove the Tannic Acid by warming and agitating the decoction with Lead Oxide. (3) Evaporate the solution. Salicin crystallizes out, and is purified by repeated solution, and crystallization.

CHARACTERS.—Colorless, silky, shining crystalline needles or rhombic prisms, or a white crystalline powder; odorless, and having a very bitter taste. *Solubility.*—In 23.5 parts of water and 88.5 of Alcohol at 25°C. (77°F.); in 3.3 parts of water at 80°C. (176°F.), and 30 of Alcohol at 60°C. (140°F.); insoluble in Ether or Chloroform.

IMPURITY.—Various alkaloids, and salicylic acid.

Dose, 1 gm. (15 gr.).

ACIDUM SALICYLICUM

SALICYLIC ACID. Abv.—Acid. Salicyl. $C_7H_6O_3 = 138.05$. Orthohydroxybenzoic acid $[C_6H_4(OH)COOH]$, existing naturally in combination in various plants but generally prepared synthetically.

SOURCE.—Made by combining Sodium Carbolate with Carbon Dioxide Gas. Thus, dry Carbon Dioxide is passed through Sodium Carbolate heated to 220°C (428°F.) $2NaC_6H_5O + CO_2 = Na_2C_7H_4O_3$ (Di-sodium Salicylate), $+C_6H_6O$ (Phenol). This is treated with Hydrochloric Acid. $Na_2C_7H_4O_3 + 2HCl = 2NaCl + HC_7H_5O_3$ (Salicylic Acid).

CHARACTERS.—Fine, prismatic needles, or a bulky crystalline powder; odorless, or having a sweetish, afterwards acrid taste; permanent in the air. *Solubility.*—In 460 parts of water and 15 of boiling water; in 2.7 parts of Alcohol; also soluble in 3 parts of Ether. *Resembling Artificial Salicylic Acid.*—Strychnine, but the crystals of Strychnine are larger, colorless, non-irritating, less soluble, and their solution is very bitter.

IMPURITIES.—Iron, phenol, hydrochloric acid, coloring matter, readily carbonizable organic impurities. Orthocreosotic, metacreosotic, and paracreosotic acids, only in some specimens of artificial salicylic acid.

INCOMPATIBLES.—Spirit of nitrous ether, iron salts, lead acetate, potassium iodide, quinine salts, ethyl carbamate.

Dose, 0.750 gm. = 750 milligm. (12 gr.).

AMMONII SALICYLAS.—Ammonium Salicylate. Abv.—Ammon. Salicyl. $NH_4C_7H_5O_3 = 155.08$. It contains not less than 98 per cent. of Ammonium Salicylate, $C_6H_4(OH)COONH_4$.

SOURCE.—Obtained by neutralizing Salicylic Acid with Ammonium Carbonate, filtering, evaporating and allowing to crystallize.

CHARACTERS.—Colorless, lustrous, monoclinic prisms, or plates, or as a white, crystalline powder; odorless, and having at first a slightly saline, bitter taste, with a sweetish after-taste. *Solubility.*—In 1 part of water and 3 parts of Alcohol at 25°C. (77°F.).

IMPURITIES.—Heavy metals.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

BISMUTHI SUBSALICYLAS, *see* p. 87.

SODII SALICYLAS.—Sodium Salicylate. Abv.—Sod. Salicyl. $NaC_7H_5O_3 = 160.04$. It contains not less than 99.5 per cent. of Sodium Salicylate.

SOURCE.—Obtained by acting on Sodium Carbonate with Salicylic Acid. $2HC_7H_5O_3 + Na_2CO_3 = 2NaC_7H_5O_3 + H_2O + CO_2$. The solution may be strained through muslin and heated to expel the Carbon Dioxide.

CHARACTERS.—White, micro-crystalline powder, or in scales, or as an amorphous powder; colorless or having not more than a faint pink tinge; odorless or having a faint, characteristic odor, and a sweet, saline taste. *Solubility.*—In 0.9 part of water and in 9.2 parts of Alcohol, at 25°C. (77°F.) very soluble in boiling water or boiling Alcohol; also soluble in Glycerin.

IMPURITIES.—Sulphites, heavy metals.

INCOMPATIBLES.—Hydrobromic acid, for sodium bromide is formed and salicylic acid is precipitated; spirit of nitrous ether, ferric salts, mineral acids, quinine salts in solution, lime water, lead acetate, silver nitrate (in solution), sodium phosphate (in powder).

Dose, 1 gm. (15 gr.).

STRONTII SALICYLAS.—Strontium Salicylate. Abv.—Stront. Salicyl. $Sr(C_7H_5O_3)_2 + 2H_2O = 397.74$. It contains not less than 99 per cent. of Strontium Salicylate.

SOURCE.—5.34 parts of pure Strontium Carbonate, free from Iron, are stirred into 100 parts of hot water to which 10 parts of Salicylic Acid have been added. Heat is applied until effervescence ceases, when the product is filtered and evaporated to crystallization.

CHARACTERS.—A white, crystalline powder; odorless, and having a somewhat sweet, saline taste. *Solubility.*—In 19 parts of water and 61 of Alcohol at 25°C. (77°F.); in 3.7 parts of boiling water and 14 of boiling Alcohol.

IMPURITIES.—Barium, heavy metals.

Dose, 1 gm. (15 gr.).

METHYLIS SALICYLAS. Methyl Salicylate. Abv.—Methyl. Salicyl. $CH_3C_7H_5O_3 = 152.06$. *Synonyms.*—Oil of Gaultheria (Wintergreen). Oil of Betula (Sweet Birch). Oil of Teaberry. It contains not less than 98 per cent. of Methyl Salicylate. It is produced synthetically or is obtained by distillation from *Gaultheria procumbens* Linné (Fam. *Ericaceæ*) or from *Betula lenta* Linné (Fam. *Betulaceæ*). The label must indicate whether it has been made synthetically or distilled from either of the above-named plants.

SOURCE.—Usually obtained by heating Salicylic Acid and Methyl Alcohol together in the presence of Sulphuric Acid, the latter serving only to abstract the water as fast as eliminated. $C_6H_4OHCOOH + CH_3OH = C_6H_4(OH)COOH_3 + H_2O$. The newly formed salicylate floats on the surface of the liquid, and is subsequently purified by distillation.

CHARACTERS.—A colorless, yellowish or reddish liquid, having the characteristic odor and taste of Gaultheria. Sp. gr., 1.172 to 1.182. *Solubility.*—Miscible with Alcohol and Glacial Acetic Acid; sparingly soluble in water.

IMPURITIES.—Methyl benzoate, alcohol, chloroform, other volatile oils, petroleum.

Dose, 0.75 mil (12 ♏).

For the Therapeutics of Salicin and the Salicylates *see* p. 672.

PHENYLIS SALICYLAS

PHENYL SALICYLATE. Abv.—Phenyl. Salicyl. $C_{13}H_{10}O_3 = 214.08$. *Synonym.*—Salol. The Phenyl Ester $[C_6H_4(OH)COOC_6H_5\ 1:2]$ of Salicylic Acid.

SOURCE.—By heating Salicylic Acid with Phenol in the presence of Phosphorus Pentachloride; this withdraws the elements of water, and unites the Phenyl group with the Salicylic Acid radical.

CHARACTERS.—A white, crystalline powder, having a faint, aromatic odor, and a characteristic, taste. *Solubility.*—In 6670 parts of water and 6 of Alcohol at 25°C. (77°F.), very soluble in Ether, Chloroform, or in fixed or volatile oils.

IMPURITIES.—Sulphates, chlorides, free acids, uncombined phenol and salicylic acid.

INCOMPATIBLES.—Camphor, phenol, thymol, hydrated chloral, naphthalene, ferric chloride.

Dose, 0.300 gm. = 300 milligm. (5 gr.).

For the Therapeutics of Phenyl Salicylate *see* p. 677.

CREOSOTUM

CREOSOTE.—Abv.—Creosot. A mixture of phenols and phenol derivatives, chiefly Guaiacol and Creosol.

SOURCE.—Obtained during the distillation of wood-tar, preferably of that derived from the beech, *Fagus Sylvatica* Linné or *Fagus ferruginea* Aiton (Fam. *Fagaceæ*).

CHARACTERS.—An almost colorless or yellowish (not pinkish), highly refractive, oily liquid, having a penetrating smoky odor, and a burning, caustic taste. It does not become brown on exposure to light. Sp. gr., not below 1.073. *Solubility.*—Slightly soluble in water, but without forming a perfectly clear solution; it is miscible with Alcohol, Ether, or fixed or volatile oils.

IMPURITIES.—Phenol (which coagulates albumin and collodion; Creosote does not); so-called "coal-tar creosote," hydrocarbons and bases, cœrulignol and some other high-boiling constituents of wood-tar.

INCOMPATIBLES.—Silver, gold, cupric and ferric salts, acacia, albumin, oxidizers. Explodes when mixed with silver oxide.

Dose, 0.25 mil (4 ♏).

Preparation

Aqua Creosoti.—Creosote Water. Abv.—Aq. Creosot. Creosote, 10; Distilled water, recently boiled, to 1000.

Dose, 10 mils (2½ fl. dr.).

CREOSOTI CARBONAS.—Creosote Carbonate. Abv.—Creosot. Carb. A mixture of the Carbonates of various constituents of Creosote, chiefly Guaiacol and Creosol.

SOURCE.—Obtained by the action of Carbon Oxychloride with the Phenol-sodium compounds of Creosote.

CHARACTERS.—A clear, colorless or yellowish, viscid liquid, odorless and tasteless, or having a slight odor and taste of Creosote. On prolonged exposure to low temperature, crystals of Guaiacol Carbonate separate, which redissolve on warming. *Solubility.*—Insoluble in water; freely in Alcohol. Sp. gr., 1.145 to 1.170.

IMPURITIES.—Creosote.

Dose, 1 mil (15 ♏).

For the Therapeutics of Creosote *see* p. 595.

GUAIACOL

GUAIACOL. $C_7H_8O_2 = 124.06$. *Synonym.*—Methyl Pyrocatechin. The monomethyl Ether $[C_6H_4(OH)(OCH_3)1:2]$ of Ortho-dihydroxybenzene.

SOURCE.—Obtained from wood-tar by collecting and purifying the fraction of Creosote boiling between 200° and 205°C. (392° and 401°F.); or prepared syn-

thetically from either Catechol by methylating, or from Ortho-anisidin by diazotizing and boiling.

CHARACTERS.—A colorless, or yellowish crystalline solid, or a colorless or yellowish, strongly refractive liquid, having an agreeable aromatic odor. Sp. gr. of liquid, 1.110 to 1.114. *Solubility.*—In 53 parts of water and in 0.8 part of Glycerin at 25°C. (77°F.); but separates from it on the addition of water.

IMPURITIES.—Oily hydrocarbons.

Dose, 0.5 mil (8 ♏).

GUAIACOLIS CARBONAS.—Guaiacol Carbonate. Abv.—Guaiacol. Carb. $(C_7H_7O)_2CO_3 = 274.11$. A Guaiacol derivative, $C_6H_4(OCH_3)O)_2{\cdot}CO$.

SOURCE.—By passing Phosgene gas (Carbonyl Chloride, $COCl_2$) into Guaiacol, previously dissolved in a Sodium Hydroxide solution. The Carbonate is obtained by crystallization.

CHARACTERS.—A crystalline powder; odorless and tasteless or having a slight aromatic odor and taste. *Solubility.*—Insoluble in water; soluble in 60 parts of Alcohol, 1 of Chloroform, and 18 of Ether at 25°C. (77°F.) freely in boiling Alcohol; slightly in Glycerin or fixed oils.

IMPURITY.—Free guaiacol, readily carbonizable impurities.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Guaiacol *see* p. 596.

GROUP V.—The Purgatives

CLASS I.—THE LAXATIVES

Manna, Castor Oil

MANNA

MANNA.—The dried saccharine exudation of *Fraxinus Ornus* Linné (Fam. *Oleaceæ*). *Habitat.*—Basin of the Mediterranean.

CHARACTERS.—In irregular, more or less elongated, flattish, 3-sided pieces; externally yellowish-white; friable, somewhat waxy; internally nearly white, porous and crystalline in appearance, odor slight but characteristic; taste sweet, slightly bitter and faintly acrid. Manna also occurs in irregular masses, consisting in part of brittle or soft, resin-like fragments; from yellowish-white to yellowish-gray in color. The quantity of yellowish-white fragments must not be less than 40 per cent. of the whole. On heating 5 parts of Manna with 100 parts of Alcohol to boiling, and filtering, the filtrate should rapidly deposit crystals of Mannite.

COMPOSITION.—The chief constituents are—(1) *Mannite,* $C_6H_8(OH)_6$, 90 per cent. (2) Glucose. (3) Fraxin, $C_{22}H_{16}O_{20}$. (4) Mucilage. (5) Resin.

Dose, 15 gm. (240 gr.).

Manna is contained in Infusum Sennæ Compositum.

For the Therapeutics of Manna *see* p. 653.

OLEUM RICINI

CASTOR OIL. Abv.—Ol. Ricin. A fixed oil obtained from the seeds of *Ricinus communis* Linné (Fam. *Euphorbiaceæ*). *Habitat.*—India; cultivated.

CHARACTERS.—A pale yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor, and a bland, afterwards slightly acrid and generally nauseating taste. Sp. gr., 0.945 to 0.965. *Solubility.*—It is miscible with Dehydrated Alcohol or Glacial Acetic Acid.

COMPOSITION.—The chief constituents are—(1) *Ricinolein*, $C_3H_5(C_{18}H_{34}O_3)_3$, which is the Ricinoleic Acid ($C_{18}H_{34}O_3$) Glyceride. This constitutes the chief bulk. (2) Other fixed oils, as palmitin, stearin, etc. (3) Possibly an alkaloid, *Ricinine*, not purgative. According to some authorities an active principle which has not yet been isolated.

IMPURITIES.—Foreign oils.

Dose, 15 mils (4 fl. dr.).

Castor oil is contained in Collodium Flexile.

For the Therapeutics of Castor Oil *see* p. 653.

CLASS II.—THE SIMPLE PURGATIVES

Rhubarb, Senna, Frangula, Cascara Sagrada, Aloes

RHEUM

RHUBARB.—The rhizomes and roots of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), and probably other species of *Rheum*, growing in China and Thibet, deprived of most of the bark tissues and carefully dried. *Habitat.*—Western and Central China, and Thibet.

CHARACTERS.—Subcylindrical, barrel-shaped, or conical pieces known in commerce as "rounds," or in plano-convex pieces known in commerce as "flats," or in irregularly formed pieces, frequently with perforations; it is hard and moderately heavy, attaining a length of 17 cm. and a diameter of 10 cm., often cut in pieces of variable form and size; outer surfaces yellowish-brown, mottled with alternating longitudinal striæ of grayish-white parenchyma and reddish or brownish medullary rays; small stellate groups of fibro-vascular tissue and occasionally reddish-brown cork patches, smooth and sometimes covered with a bright, brownish-yellow powder; fracture uneven and granular, presenting a characteristic mottled appearance; odor aromatic, characteristic; taste characteristic, slightly bitter and astringent, gritty when chewed and tingeing the tongue yellow.

COMPOSITION.—The chief constituents are—(1) *Chrysarobin*, $C_{28}H_{26}O_7$, which yields *Chrysaphanic Acid*, $C_{15}H_{10}O_4$; about 3 per cent. *Synonyms.*—Rhein. Crysaphan (*see* Chrysarobin, p. 241). It is not known if the plant, Rhubarb contains any Chrysaphanic Acid, for when kept the Chrysaphan, which gives the yellow color, quickly oxidizes to Chrysaphanic Acid. (2) *Emodin*, an anthra-

cene body ($C_{14}H_{10}$) *see* p. 657. (3) Erythroretin. (4) Phæoretin. (5) Aporetin. (6) Rheotannic Acid, $C_{28}H_{26}O_{14}$, to which the astringency is due. (7) Lime Oxalate, 35 per cent., to which the grittiness is due.

IMPURITIES.—English Rhubarb; different taste, smell, and with excess of starch. Turmeric, which is turned brown by Boric Acid.

Dose, 1 gm. (15 gr.).

Preparations

1. **Extractum Rhei.**—Extract of Rhubarb. Abv.—Ext. Rhei. By percolation, maceration and evaporation.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. **Fluidextractum Rhei.**—Fluidextract of Rhubarb. Abv.—Fldext. Rhei. By maceration and percolation with Alcohol and Water, and evaporation.

Dose, 1 mil (15 ♏).

3. **Pilulæ Rhei Compositæ.**—Compound Pills of Rhubarb. Abv.—Pil. Rhei. Co. Rhubarb, 13, Aloes, 10; Myrrh, 6; Oil of Peppermint, 0.5, to make 100 pills. Each pill contains 0.13 gm., 2 gr., of Rhubarb.

Dose, 2 pills.

4. **Pulvis Rhei Compositus.**—Compound Powder of Rhubarb. Abv.—Pulv. Rhei. Co. *Synonym.*—Gregory's powder. Rhubarb, 25; Magnesium Oxide, 65; Jamaica Ginger, 10.

Dose, 2 gm. (30 gr.).

5. **Syrupus Rhei.**—Syrup of Rhubarb. Abv.—Syr. Rhei. Fluidextract of Rhubarb, 100; Potassium Carbonate, 10; Spirit of Cinnamon, 4; Water, 50, Syrup to 1000. By solution.

Dose, 10 mils (2½ fl. dr.).

6. **Syrupus Rhei Aromaticus.**—Aromatic Syrup of Rhubarb. Abv.—Syr. Rhei. Arom. *Synonym.*—Spiced Syrup of Rhubarb. Aromatic Tincture of Rhubarb, 150; Potassium Carbonate, 1; Syrup to 1000. By mixture.

Dose, 10 mils (2½ fl. dr.).

7. **Tinctura Rhei.**—Tincture of Rhubarb. Abv.—Tr. Rhei. Rhubarb, 200; Cardamom Seed 30. By maceration and percolation, with Glycerin, Alcohol and Water to 1000.

Dose, 4 mils (1 fl. dr.).

8. **Tinctura Rhei Aromatica.**—Aromatic Tincture of Rhubarb. Abv.—Tr. Rhei. Arom. Rhubarb, 200; Saigon Cinnamon, 40; Clove, 40; Myristica, 20. By maceration and percolation with Glycerin, Alcohol and water, to 1000.

Dose, 2 mils (30 ♏).

For the Therapeutics of Rhubarb *see* p. 657.

SENNA

SENNA. Abv.—Senn. The dried leaflets of *Cassia acutifolia* Delile, known in commerce as Alexandria Senna, or of *Cassia angustifolia* Vahl, known in commerce as India Senna, (Fam. *Leguminosæ*), without the presence or admixture of more than 10 per cent. of stem tissues, pods, seeds and other impurities.

CHARACTERS.—*Cassia acutifolia.*—Usually unbroken, occasionally in fragments, leaflets inequilaterally lanceolate or lance ovate, from 2 to 3.5 cm. in length and from 6 to 10 mm. in breadth, having extremely short, stout petioles; acutely cuspidate, entire, subcoriaceous, brittle, pale green or grayish-green, sparsely and obscurely hairy, especially beneath, the hairs appressed; odor characteristic; taste somewhat mucilaginous and bitter. *Habitat.*—Eastern and Central Africa.

Cassia angustifolia. Synonym.—Tinnivelly Senna. Leaflets usually unbroken, from 2 to 5 cm. in length and from 6 to 14 mm. in breadth, usually more abruptly pointed than those of Alexandria Senna, yellowish-green, and smooth above, paler beneath; in odor and taste closely resembling Alexandria Senna. *Habitat.*—Eastern Africa to India cultivated.

Resembling Senna.—Argel leaves (the leaves of *Solenostemma Argel*) Hayne Fam. *Asclepiadeæ*), which are sometimes present in Alexandria Senna and which are equilateral, 1-veined, thick, wrinkled, glaucous, and possess 3-celled hairs. These leaves are similar to those of Uva Ursi and Buchu.

COMPOSITION.—The chief constituents are—(1) *Cathartinic Acid*, $C_{180}H_{192}N_{82}SO_2$, an amorphous sulphurated glucoside. It exists as salts of earthy bases, such as Calcium and Magnesium, which are soluble in water. Cathartinic Acid is capable of decomposition into glucose and *Cathartogenic Acid.* (2) *Emodin*, an anthracene body, *see* p. 657. (3) Sennacrol and Sennapicrin, $C_{34}H_{38}O_{17}$, glucosides, which do not, in most preparations, contribute to their action as they are insoluble in water. (4) *Chrysophanic Acid* in small amounts as a coloring matter (*see* p. 160).

Dose, 4 gm. (60 gr.).

Preparations

1. **Fluidextractum Sennæ.**—Fluidextract of Senna. Abv.—Fldext. Senn. By maceration, percolation with Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).

Fluidextract of Senna is used to prepare Syrupus Sarsaparillæ Compositus.

2. **Infusum Sennæ Compositum.**—Compound Infusion of Senna. Abv.—Inf. Senn. Co. *Synonym.*—Black Draught. Senna, 60; Manna, 120; Magnesium Sulphate, 120; Fennel, 20; Boiling water to 1000.

Dose, 120 mils (4 fl. oz.).

3. **Pulvis Glycyrrhizæ Compositus.**—Compound Powder of Glycyrrhiza. Abv.—Pulv. Glycyrrh. Co. *Synonym.*—Compound Licorice

Powder. Senna, 180; Glycyrrhiza, 236; Oil of Fennel, 4; Washed Sulphur, 80; Sugar, 500.

Dose, 4 gm. (60 gr.).

4. **Syrupus Sennæ.**—Syrup of Senna. Abv.—Syr. Senn. Fluidextract of Senna, 250; Oil of Coriander, 5; Syrup to 1000.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Senna *see* p. 660.

FRANGULA

FRANGULA. Abv.—Frang. *Synonym.*—Buckthorn Bark. The dried bark of *Rhamnus Frangula* Linné (Fam. *Rhamnaceæ*). *Habitat.*—Europe and Northern Asia.

CHARACTERS.—In quills varying in length, frequently flattened or crushed; from 0.15 to 1 mm. in thickness; outer surface grayish-brown to purplish-black with numerous prominent, lighter-colored, transverse lenticels and occasional patches of foliaceous lichens; bearing small, blackish apothecia; inner surface smooth, dark brown with occasional purplish blotches, longitudinally striate, becoming red when moistened with solutions of the alkalies; fracture short, slightly fibrous in the inner layer; odor distinctive; taste slightly bitter.

COMPOSITION.—Fresh bark contains a glucoside, *Frangulin*, $C_{20}H_{20}O_{10}$. This in the old bark has become converted into *Emodin*, an anthracene body (*see* p. 657), to which the value of the bark is due. Two products are obtained from Frangulin by hydrolysis, *Emodin* and *Rhamnose*, $C_6H_{12}O_5$.

Dose, 1 gm. (15 gr.).

Preparation

Fluidextractum Frangulæ.—Fluidextract of Frangula. Abv.—Fldext. Frangul. By maceration and percolation with Alcohol and water, and evaporation.

Dose, 1 mil (15 ♏).

For the Therapeutics of Frangula *see* p. 659.

CASCARA SAGRADA

CASCARA SAGRADA. *Synonyms.*—Sacred Bark. Chittem Bark. Rhamnus Purshiana. The dried bark of *Rhamnus Purshiana* De Candolle (Fam. *Rhamnaceæ*). *Habitat.*—Northern Idaho, and westward to the Pacific Coast.

CHARACTERS.—Usually in flattened or transversely curved pieces, occasionally in quills; bark from 1 to 5 mm. in thickness; outer surface dark brown or brownish-red, longitudinally ridged, often nearly covered with grayish or whitish lichens, bearing small, blackish apothecia, sometimes with numerous lenticels, and occasionally with mosses; inner surface light yellow, light brown, or reddish-brown, longitudinally striate, turning red when moistened with solutions of the

alkalies; fracture short, with projections of bast fibres in the inner bark; on cross section inner bark shows diagonal or curved medullary rays, forming converging groups, the outer bark showing yellowish group of stone cells which are especially apparent on moistening the freshly cut surface with phloroglucinol test solution and hydrochloric acid; odor distinct; taste disagreeable, bitter, and slightly acrid.

COMPOSITION.—The chief constituents are—(1) *Cascarin*, a glucoside said to be identical with *Frangulin* (*see* p. 163), which is converted into an anthracene body. (2) Three resins. (3) Acids. (4) A volatile oil. The fresh bark causes much griping, but this unpleasant effect is lost if the bark is kept and properly cured.

Dose, 1 gm. (15 gr.).

Preparations

1. **Extractum Cascaræ Sagradæ.**—Extract of Cascara Sagrada. Abv.—Ext. Cascr. Sagr. By maceration and percolation with Alcohol and Water; evaporation, and addition of Magnesium Oxide and Starch.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. **Fluidextractum Cascaræ Sagradæ.**—Fluidextract of Cascara Sagrada. Abv.—Fldext. Cascar. Sagr. By maceration and percolation with Alcohol and Water, and evaporation.

Dose, 1 mil (15 ♏).

3. **Fluidextractum Cascaræ Sagradæ Aromaticum.**—Aromatic Fluidextract of Cascara Sagrada. Abv.—Fldext. Cascar. Sagr. Arom. Cascara Sagrada, 1000; Extract of Glycyrrhiza, 40, Magnesium Oxide, 125; Glycerin, 200; Alcohol, 250; Benzosulphinide, 1; Oil of Anise, 2.5; Oil of Cassia, 0.2; Oil of Coriander, 0.1; Methyl Salicylate, 0.2; Boiling water to 10000. By maceration and percolation with Alcohol and Water, and evaporation, with the addition of sufficient water to make 1000.

Dose, 2 mils (30 ♏).

For the Therapeutics of Cascara Sagrada *see* p. 659.

ALOE

ALOES.—The inspissated juice of the leaves of *Aloe Perryi* Baker, yielding Socotrine Aloes; or *Aloe vera* Linné, yielding Curaçao Aloes; or of *Aloe ferox* Miller, yielding Cape Aloes (Fam. *Liliaceæ*). *Habitat.*—Island of Barbadoes; Eastern Africa, and other regions in the Orient.

CHARACTERS. *Aloe Perryi.*—In yellowish-brown to blackish-brown opaque, or smooth and glistening masses; fractured surface somewhat conchoidal; sometimes soft or semi-liquid; odor aromatic or saffron-like, never fetid or putrid; taste nauseous, bitter. Not less than 50 per cent. of Socotrine Aloes is soluble in cold water, the solution being of a yellowish-color.

Aloe vera.—In orange to blackish-brown, opaque masses; fractured surface uneven, waxy, somewhat resinous; odor characteristic but not aromatic as in Socotrine Aloes. Not less than 60 per cent. of Curaçao Aloes is soluble in cold water, the solution being of a purplish-red color.

Aloe ferox.—In reddish-brown or olive-black masses, usually covered with a yellowish powder, or in thin, transparent fragments of a reddish-brown color; fracture smooth and glassy; odor characteristic. Not less than 60 per cent. of Cape Aloes is soluble in cold water, the solution being of a pale yellow color.

COMPOSITION.—(1) *Aloin*, an anthracene body ($C_{14}H_{10}$) *see* p. 657. (2) A Resin. (3) A trace of Gallic Acid. (4) A trace of a volatile oil giving the odor. *Resembling Aloes.*—Resins of Jalap and Guaiac, and Gambir.

IMPURITIES.—Gum, dextrin, inorganic matters.

Aloes is contained in Extractum Colocynthidis Compositum, Pilulæ Rhei Compositæ and Tinctura Benzonini Composita.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparations

1. **Pilulæ Aloes.**—Pills of Aloes. Abv.—Pil. Aloes. Aloes, 13; Soap, 13; water to make 100 pills. Each pill contains .13 gm.; 2 gr., of Aloes. **Dose, 2 pills.**

2. **Tinctura Aloes.**—Tincture of Aloes. Abv.—Tr. Aloes. Aloes, 100; Glycyrrhiza, 200. Macerate with Diluted Alcohol and percolate to 1000. **Dose, 2 mils (30 ♏).**

ALOINUM.—Aloin. A pentoside or mixture of pentosides obtained from Aloes, varying in chemical composition, physical and chemical properties according to the source.

CHARACTERS.—A micro-crystalline powder, or minute, acicular crystals, lemon-yellow to dark yellow in color, odorless or possessing a slight odor of Aloes and an intensely bitter taste. It becomes darker on exposure to light and air. *Solubility.*—It varies in solubility according to its composition; being soluble in water, Alcohol, or Acetone; slightly soluble in Ether.

IMPURITIES.—Isobarbaloin, resinous and other matters.

Dose, 0.015 gm. = 15 milligm. (¼ gr.).

For the Therapeutics of Aloes *see* p. 655.

CLASS III.—THE DRASTIC PURGATIVES

Scammony Root, Jalap, Croton Oil, Colocynth, Elaterin, Gamboge, Podophyllum, Colchicum

SCAMMONIÆ RADIX

SCAMMONY ROOT. Abv.—Scam. Rad. The dried root of *Convolvulus Scammonia* Linné (Fam. *Convolvulaceæ*), yielding not less than 8 per cent. of the total resins of Scammony Root. *Habitat.*—Western Asia.

CHARACTERS.—Cylindrical or somewhat tapering, from 10 to 25 cm. in length and from 1 to 4.5 cm. in thickness; externally grayish- to reddish-brown; usually distinctly twisted, deeply longitudinally furrowed, marked by distinct

root-scars, otherwise nearly smooth except for the lenticels and abraded cork, the upper portion terminated usually by a number of short stem branches; hard and heavy; fracture tough, irregular and with projecting wood-fibers; internally somewhat mottled, showing yellowish, porous wood-wedges separated by whitish parenchyma containing starch and resin, bark thin; odor slight, resembling that of Jalap; taste very slightly sweet, becoming slightly acrid.

IMPURITIES.—Chalk and starch.

COMPOSITION.—The chief constituents are—(1) The official resin (*see* below). (2) Gum, 10 to 20 per cent. (3) Starch.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Resina Scammonii.—Resin of Scammony. Abv.—Res. Scamm.

SOURCE.—Digest Scammony root with successive portions of boiling Alcohol, distil off the Alcohol, precipitate the Resin with water, wash it thoroughly, and dry with gentle heat.

Characters.—Brownish translucent masses of fragments, breaking with a glossy, resinous fracture; odor characteristic and agreeable. *Solubility.*—In Alcohol in all proportions; not less than 95 per cent. is soluble in Ether (distinction from Resin of Jalap and resin of false Scammony). Ammonia Water and solutions of alkali hydroxides dissolve it with the aid of a gentle heat.

COMPOSITION.—The chief constituent is *Scammonium*, $C_{68}H_{106}O_{42}$, probably the same as *Jalapin* (*see* p. 167).

IMPURITY.—Rosin.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

Resin of Scammony is contained in Extractum Colocynthidis Compositum.

For the Therapeutics of Scammony Root *see* p. 662.

JALAPA

JALAP.—The dried tuberous root of *Exogonium Purga* (Wenderoth) Bentham (Fam. *Convolvulaceæ*), yielding not less than 7 per cent. of the total resins of Jalap. *Habitat.*—Eastern Mexico.

CHARACTERS.—Fusiform, irregularly ovoid or pyriform, upper end more or less rounded, lower end slightly tapering, the large roots often incised or cut into pieces; from 4 to 15 cm. in length and from 12 to 60 mm. in diameter; externally dark brown, longitudinally wrinkled or furrowed and with numerous lenticels; hard, compact, not fibrous; when broken, internally dark brown, mealy or waxy, bark from 1 to 2 mm. in thickness, outer bundles separated from the outer cortical layer by a distinct, brown cambium zone; odor slight, but distinctive, smoky; taste somewhat sweet and acrid.

COMPOSITION.—The chief constituents are—(1) The official *resin* (*see* p. 167), mostly *Jalapurgin*, $C_{62}H_{100}O_{32}$. (2) A soft resin.

Dose, 1 gm. (15 gr.).

Preparations

1. **Pulvis Jalapæ Compositus.**—Compound Powder of Jalap. Abv. —Pulv. Jalap Co. *Synonym.*—Pulvis Purgans. Jalap, 35; Potassium Bitartrate, 65.

Dose, 2 gm. (30 gr.).

2. **Resina Jalapæ.**—Resin of Jalap. Abv.—Res. Jalap.

SOURCE.—By maceration with Alcohol, percolation, distillation of the Alcohol, and precipitation with water and drying.

CHARACTERS.—Yellow to brown colored masses or fragments, breaking with a resinous, glassy fracture, translucent at the edges, or a yellowish-gray to yellowish-brown powder, having a slight, peculiar odor, and a somewhat acrid taste. *Solubility.*—In Alcohol in all proportions; insoluble in Carbon Disulphide, Benzene, or fixed or volatile oils.

COMPOSITION.—The chief constituents are—(1) *Jalapurgin*, or *Convolvulin*, $C_{62}H_{100}O_{32}$, a glucoside, insoluble in Ether, more irritant than *Jalapin*, and probably the most active ingredient of Jalap. (2) *Jalapin*, probably identical with *Scammonin*, a soft resinous substance, soluble in Ether, is found in Jalap wood and Stalk. (3) Starch and Gum. *Resembling Jalap Resin.*—Aloes, which is bitter.

IMPURITIES.—Saponifiable substances, rosin, orizaba, guaiac, and other resins.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

Resin of Jalap is contained in Pilulæ Catharticæ Compositæ.

For the Therapeutics of Jalap *see* p. 662.

OLEUM TIGLII

CROTON OIL. Abv.—Ol. Tiglii. A fixed oil expressed from the seeds of *Croton Tiglium* Linné (Fam. *Euphorbiaceæ*). *Habitat.*—India and Philippine Islands; cultivated.

CHARACTERS.—A pale yellow or brownish-yellow, somewhat viscid, and slightly fluorescent liquid, having a slight characteristic odor,. *Great caution is necessary in tasting it, and it must be handled carefully as it causes a pustular eruption when applied to the skin.* Sp. gr., 935 to 950. *Solubility.*—Slightly in Alcohol, the solubility increasing by age; freely soluble in Ether, Chloroform, or fixed or volatile oils.

COMPOSITION.—The chief constituents are—(1) Several volatile acids (1 per cent. in all); these give the odor. *Crotonoleic Acid*, $C_8H_8O_2$, is the characteristic one; the others are Acetic, Isobutyric, Isovaleric, Formic, Lauric, Myristic, Palmitic, Stearic, existing as glycerides. (2) Several fatty acids, both free and combined to form fats. (3) *Crotonol*, $C_{18}H_{28}O_4$, a resinous substance which is non-purgative, but is capable of causing cutaneous irritation.

IMPURITIES.—Other non-drying oils.

Dose, 0.05 mil (1 ♏).

For the Therapeutics of Croton Oil *see* p. 666.

COLOCYNTHIS

COLOCYNTH. Abv.—Colocyn. *Synonyms.*—Bitter Apple. Bitter Gourd. Bitter Cucumber. The dried pulp of the fruit of *Citrullus Colocynthis*, Schrader (Fam. *Cucurbitaceæ*). *Habitat.*—Southern and Western Asia, Northern and Southern Africa, Greece and Spain.

CHARACTERS.—Fruits, before removal of the seeds, nearly globular, from 4 to 7 cm. in diameter, usually more or less crushed and in broken pieces, with occasional patches of the nearly smooth epicarp; yellow-white or brownish; light, spongy; separable longitudinally when entire into three carpels, each containing, near the outer surface, the ovoid, compressed, yellowish seeds; odor slight; taste intensely bitter.

IMPURITIES.—Seeds and cortex.

COMPOSITION.—The chief constituents are—(1) *Colocynthin*, $C_{56}H_{34}O_{23}$, about 2 per cent., an amorphous or crystalline, bitter, active glucoside, readily soluble in water and Alcohol. (2) Resinous matter having the names of Citrullin, Colocynthein and Colocynthitin, insoluble in water.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Extractum Colocynthidis.**—Extract of Colocynth. Abv.—Ext. Colocynth. By maceration with Diluted Alcohol, expression and straining; percolation and evaporation.

   Dose, 0.03 gm. = 30 milligm. (½ gr.).

2. **Extractum Colocynthidis Compositum.**—Compound Extract of Colocynth. Abv.—Ext. Colocynth. Co. Extract of Colocynth, 160; Aloes, 500; Cardamom Seed, 50; Resin of Scammony, 140; Soap, 150. By reducing to powder and sifting.

   Dose, 0.25 gm. = 250 milligm. (4 gr.).

3. **Pilulæ Catharticæ Compositæ.**—Compound Cathartic Pills. Abv.—Pil. Cath. Co. Mild Mercurous Chloride, 60; Compound Extract of Colocynth, 80; Resin of Jalap, 20; Gamboge, 15; Diluted Alcohol, a sufficient quantity, to make 1000 pills.

   Dose, 2 pills.

For the Therapeutics of Colocynth *see* p. 664.

ELATERINUM

ELATERIN.—A principle obtained from Elaterium, a substance deposited by the juice of the fruit of *Ecballium Elaterium* (Linné) A. Richard (Fam. *Cucurbitaceæ*). *Synonym.*—Squirting Cucumber.

SOURCE.—Exhaust Elaterium with Chloroform. Add Ether, wash the resulting precipitate with Ether; purify by re-crystallization with Chloroform.

CHARACTERS.—Minute, white, hexagonal scales, or prismatic crystals, odorless and having a slightly acrid, bitter taste; permanent in the air. *Solubility.*—In 325 parts of Alcohol, 450 of Ether, 15.5 of Chloroform, 310 of Benzene, 25°C. (77°F.); insoluble in either cold or hot water.

IMPURITIES.—Alkaloids, readily carbonizable impurities.

Dose, 0.003 gm. = 3 milligm. (1/20 gr.).

Preparation

Trituratio Elaterini.—Trituration of Elaterin. Abv.—Trit. Elaterin. Elaterin, 10; Sugar of Milk, 90.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

For the Therapeutics of Elaterin *see* p. 665.

CAMBOGIA

GAMBOGE. Abv.—Cambog. *Synonym.*—Pipe Gamboge. A gum-resin obtained from *Garcinia Hamburii* Hooker filius (Fam *Guttiferæ*). *Habitat.*—Anam, Camboja and Siam.

CHARACTERS.—In hard, brittle cylindrical pieces, usually hollow in the centre, from 10 to 20 cm. in length, from 2 to 5 cm. in diameter, externally grayish-orange-brown, longitudinally striate; fracture conchoidal, smooth, orange-red; odorless; taste very acrid. *Solubility.*—Not less than 65 per cent. of Gamboge is soluble in Alcohol.

COMPOSITION.—The chief constituents are—(1) A brilliant yellow Resin, *Gambogic Acid*, 65 to 80 per cent. (2) Gum, 16 to 26 per cent. This is soluble, so that an emulsion of Gambogic Acid is formed with water.

IMPURITIES.—Starch, woody fibre.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

Gamboge is contained in Pilulæ Catharticæ Compositæ.

For the Therapeutics of Gamboge *see* p. 663.

PODOPHYLLUM

PODOPHYLLUM. Abv.—Podoph. *Synonyms.*—May Apple. Mandrake The dried rhizome of *Podophyllum peltatum* Linné (Fam. *Berberidaceæ*), yielding not less than 3 per cent. of Resin. *Habitat.*—North America, in rich woods and thickets.

CHARACTERS.—Rhizome horizontal, nearly cylindrical, jointed, compressed on the upper and lower surfaces, sometimes branched, in pieces from 3 to 20 cm. in length, the internodes 2 to 9 mm. in diameter; externally dark brown, longitudinally wrinkled or nearly smooth with irregular, somewhat V-shaped scars of scale leaves, nodes annulate, the upper portion marked with large, circular, depressed stem-scars and sometimes with buds or stem-bases; at or near the nodes on the lower portion occur numerous root-scars or roots from 2

to 7 cm. in length and about 2 mm. in thickness; fracture short; internally, bark light brown, wood with small yellowish vascular bundles, pith large and white; odor slight; taste sweetish and disagreeably bitter and acrid.

COMPOSITION.—The chief constituents are—(1) The official *Resin* (*see* below). (2) Podophyllic acid, a coloring principle.

Preparations

1. **Fluidextractum Podophylli.**—Fluidextract of Podophyllum. Abv.—Fldext. Podophyll. By maceration and percolation with Alcohol and Water, distillation of the Alcohol and solution.

Dose, 0.5 mil (8 ♏).

2. **Resina Podophylli.**—Resin of Podophyllum. Abv.—Res. Podoph. *Synonym.*—Podophyllin.

SOURCE.—By maceration and percolation with Alcohol, distillation of the Alcohol, precipitation of Resin in Hydrochloric Acid and water; wash and dry.

CHARACTERS.—An amorphous powder, varying in color from light brown to greenish-yellow, turning darker when subjected to a heat exceeding 25°C. (77°F.) or when exposed to light. It has a slight, peculiar odor, and a faintly bitter taste. *It is very irritating to the eyes, and to mucous membranes. Solubility.*—In Alcohol, with only a slight opalescence; not less than 75 per cent. of it should be soluble in Ether, and not less than 65 per cent. in Chloroform.

COMPOSITION.—The Resin consists mainly of *Podophyllotoxin*, $C_{22}H_{24}O_8+2H_2O$, which is said to be a mixture of *Picropodophyllin*, 75 to 80 per cent., the purgative principle, and Picropodophyllic Acid, both existing free in the rhizome; with these are associated minor resins, and Podophylloquercitin, a coloring principle.

INCOMPATIBLES.—Water precipitates it from Alcohol; acids precipitate it from Ammonia.

Dose 0.01 gm. = 10 milligm. (⅙ gr.).

For the Therapeutics of Podophyllum *see* p. 667.

COLCHICUM

COLCHICI CORMUS.—Colchicum Corm. Abv.—Colch. Corm. The dried corm of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding not less than 0.35 per cent. of Colchicine. *Synonym.*—Meadow Saffron. *Habitat.*—Southern and Central Europe.

CHARACTERS.—Usually in reniform, transverse or in ovate, longitudinal slices; from 2 to 5 mm. in thickness; flat surfaces, whitish, slightly roughened, and of a crystalline appearance under a hand lens; epidermis thin, light brown and finely wrinkled; fracture short and mealy; odor slight; taste bitter and somewhat acrid.

COMPOSITION.—The chief constituents are—(1) *Colchicine*, $C_{25}H_{25}O_6N$, the alkaloid (*see* below). It is changed by most acids into *Colchiceine*, $C_{22}H_{23}NO_6$. (2) *Veratrine* (*see* p. 142), in traces combined with Gallic Acid. (3) Starch. (4) Sugar. (5) Gum.

INCOMPATIBLES.—All astringent preparations, tincture of iodine, tincture of guaiac.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Extractum Colchici Cormi.—Extract of Colchicum Corm. Abv.—Ext. Colch. Corm. It yields not less than 1.25 per cent. nor more than 1.55 per cent. of Colchicine. By maceration and percolation with Purified Petroleum Benzin, Alcohol and water, decantation and evaporation.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

COLCHICI SEMEN.—Colchicum Seed. Abv.—Colch. Sem. The dried seeds of *Colchicum autumnale* yielding not less than 0.45 per cent. of Colchicine.

CHARACTERS.—Ovoid or irregularly globular, more or less pointed at the hilum; from 2 to 3 mm. in diameter; when fresh, several seeds cohering; externally dark brown, finely pitted; tough and of almost bony hardness; internally whitish or light brown; nearly inodorous; taste bitter and somewhat acrid. *Resembling Colchicum seed.*—Black mustard seed.

COMPOSITION.—The chief constituents are—The same as of the Corm and a fixed oil, 6 to 8 per cent.

Dose, 0.200 gm. = 200 milligm. (3 gr.).

Preparations

1. Fluidextractum Colchici Seminis.—Fluidextract of Colchicum Seed. Abv.—Fldext. Colch. Sem. It yields not less than 0.36 nor more than 0.44 per cent. of Colchicine. By percolation with Purified Petroleum Benzin, Alcohol and water.

Dose, 0.2 mils (3 ♏).

2. Tinctura Colchici Seminis.—Tincture of Colchicum Seed. Abv.—Tr. Colch. Sem. It yields not less than 0.036 per cent. nor more than 0.044 per cent. of Colchicine. Colchicum Seed, 100; by maceration and percolation with Alcohol and water to 1000.

Dose, 2 mils (30 ♏).

COLCHICINA.—Colchicine, $C_{22}H_{25}O_6N = 399.21$. An alkaloid obtained from Colchicum.

SOURCE.—By exhausting with Alcohol, diluting with water, filtering, precipitating coloring-matter with Lead Subacetate, removing the Lead with Sodium Phosphate, precipitating Colchicine with Tannic acid; digest the washed tannate with Lead Oxide, dry, and dissolve out Colchicine with Alcohol. Colchicine

may also be made synthetically from Colchiceine, Sodium Methylate, and Methyl Iodide, which are heated together.

CHARACTERS.—Pale yellow amorphous scales, or as a pale yellow amorphous powder, turning darker on exposure to light; odorless or nearly so. *Great caution should be used in tasting it and then only in very dilute solutions.* *Solubility.*—In 22 parts of water, 220 of Ether, and 100 of Benzene; freely soluble in Alcohol and Chloroform; insoluble in Petroleum Benzin.

INCOMPATIBLES.—Those common to all alkaloids, *see* p. 122.

Dose, 0.0005 gm. = 0.5 milligm. (1/1120 gr.).

For the Therapeutics of Colchicum *see* p. 668.

GROUP VI.—Drugs Having Chiefly a Diuretic Action

Theophylline, Theobromine Sodio-Salicylate, Uva Ursa, Triticum, Sabal, Benzoin

THEOPHYLLINA

THEOPHYLLINE. Abv.—Theophyll. *Synonym.*—Dimethylxanthine. An organic base ($C_7H_8O_2N_4+H_2O$ or $1:3C_5H_2(CH_3)_2\cdot O_2N_4+H_2O=198.12$) isomeric with Theobromine. It is found in small amounts in the leaves of *Thea sinensis* Linné (Fam. *Ternstræmiaceæ*) and is also prepared synthetically.

CHARACTERS.—A white, crystalline powder; odorless and having a bitter taste. It is permanent in the air. *Solubility.*—In 100 parts of water and 80 parts of Alcohol at 25°C. (77°F.). It is more readily soluble in hot water; sparingly soluble in Ether. It is readily soluble in solutions of the alkali hydroxides and in Ammonia water.

IMPURITIES.—Caffeine, theobromine, or paraxanthine, organic impurities.

Dose, 0.25 gm. = 250 milligm. (4 gr.).

For the Therapeutics of Theophylline *see* p. 570.

THEOBROMINÆ SODIO-SALICYLAS

THEOBROMINE SODIO-SALICYLATE. Abv.—Theobrom. Sodio-Sal. Sodium Theobromine ($C_7H_7O_2N_4Na=202.10$) and Sodium Salicylate ($NaC_7H_5O_3=160.04$) in approximately molecular proportions. It yields, when dried to a constant weight, not less than 46.5 per cent. of Theobromine ($C_7H_8O_2N_4=180.10$).

SOURCE.—By interaction between Sodium Theobromine and Sodium Salicylate.

CHARACTERS.—A white, odorless powder, of a sweetish, saline, and somewhat alkaline taste. It gradually absorbs carbon dioxide from the air with the liberation of theobromine, becoming partially insoluble in water. *Solubility.*—In 1 part of water at 25°C. (77°F.); slightly soluble in Alcohol.

IMPURITIES.—Caffeine, sodium carbonate, organic impurities.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Theobromine Sodio-salicylate *see* p. 571.

UVA URSI

UVA URSI. *Synonym.*—Bearberry. The dried leaves of *Arctostaphylos Uva-ursi* (Linné) Sprengel (Fam. *Ericaceæ*), without the presence or admixture of more than 5 per cent. of stems or other foreign matter. *Habitat.*—Northern Hemisphere, in dry and sandy or rocky places; in the United States, south to Pennsylvania, New Mexico, and California.

CHARACTERS.—Usually more or less entire, laminæ obovate or oblong-spatulate, from 12 to 30 mm. in length and from 5 to 13 mm. in breadth, summits obtuse or rounded; margins entire, slightly revolute; bases cuneate, tapering into short and stout petioles; upper surfaces dark green, glabrous and shiny, finely reticulate; under surfaces yellowish-green and slightly pubescent, especially under the midribs; coriaceous, fracture short; odor aromatic, tea-like, taste astringent and somewhat bitter. *Resembling Uva Ursi.*—Senna and Buchu.

COMPOSITION.—The chief constituents are—(1) *Arbutin*, $C_{12}H_{16}O_7$, a bitter, crystalline glucoside yielding glucose, hydroquinone and methyl-hydroquinone. (2) *Ericolin*, $C_{16}H_{16}O$, a bitter, crystalline glucoside. (3) Ursone, a tasteless neutral body. (4) Tannic Acid, 6 to 7 per cent. (5) Gallic Acid.

INCOMPATIBLES.—Iron, lead and silver salts, gelatin, opium, infusion of cinchona, spirit of nitrous ether, alkalies, tartar emetic.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Uvæ Ursi.—Fluidextract of Uva Ursi. Abv.—Fldext. Uvæ Ursi. By maceration and percolation with Glycerin, Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).

For the Therapeutics of Uva Ursi *see* p. 572.

TRITICUM

TRITICUM. Abv.—Tritic. *Synonyms.*—Couch Grass. Dog Grass. The dried rhizome and roots of *Agropyron repens* (Linné) Beauvois (Fam. *Gramineæ*), gathered in the spring. *Habitat.*—Europe and North America.

CHARACTERS.—Usually in pieces from 4 to 12 mm. in length and from 1 to 2.5 mm. in diameter; externally light yellow or yellowish-brown, longitudinally furrowed, smooth, lustrous nodes with leaf-scars, a few root-scars, and occasional slender roots; fracture tough, fibrous; internally lemon-yellow and with a large, hollow pith; odor slight, aromatic; taste sweetish.

COMPOSITION.—(1) *Triticin*, about 8 per cent., a gummy substance resembling Inulin. (2) Inosite. (3) Malates.

Dose, 8 gm. (120 gr.).

Preparation

Fluidextractum Tritici.—Fluidextract of Triticum. By percolation with boiling water, evaporation, addition of Alcohol and filtration.

Dose, 10 mils (2½ fl. dr.).

For the Therapeutics of Triticum *see* p. 573.

SABAL

SABAL. *Synonym.*—Saw Palmetto Berries. The partially dried, ripe fruit of *Serenoa serrulata* (Michaux) Hooker filius (Fam. *Palmæ*). *Habitat.*—Southern Atlantic and Gulf Coasts of the United States.

CHARACTERS.—Elipsoidal or ovoid, occasionally compressed, from 1.5 to 3 cm. in length and from 1 to 1.5 cm. in diameter; externally brownish-black to bluish-black, smooth and somewhat oily, with a few large, more or less angular depressions, due to the contraction of the inner layer in drying, summit marked by a scar of the style, and the base either with a short stalk or stem-scar; epicarp and sarcocarp together forming a thin, coriaceous shell enclosing a hard but thin endocarp, which is externally reddish-brown and somewhat fibrous as is also the inner layer in the sarcocarp; inner layer of endocarp smooth, enclosing a hard, ellipsoidal or ovoid, somewhat flattened, reddish-brown seed; odor pronounced, aromatic; taste sweetish, aromatic, slightly acrid.

COMPOSITION.—(1) *Volatile Oil*, having a green color and an odor resembling that of old cheese, ½ to 1 per cent. (2) *Fixed Oils*, one being of a light lemon color. and the other a greenish-brown, 12 to 15 per cent. (3) Resin. (4) Dextrin. (5) Glucose.

Dose, 1 gm. (15 gr.).

Preparation

Fluidextractum Sabal.—Fluidextract of Sabal. Abv.—Fldext. Sabal. *Synonym.*—Fluidextract of Saw Palmetto. By maceration, percolation and concentration and dilution with alcohol and water.

Dose, 1 mil (15 ♏).

For the Therapeutics of Sabal *see* p. 572.

BENZOINUM

BENZOIN. *Synonym.*—Gum Benjamin. A balsamic resin obtained from *Styrax Benzoin* Dryander, and some other species of *Styrax* (Fam. *Styraceæ*). *Habitat.*—East Indies.

CHARACTERS.—**Sumatra Benzoin.**—In blocks or lumps of varying size, made up of tears, compacted together with a reddish-brown, reddish-gray, or grayish-brown resinous mass; tears internally yellowish or rusty-brown, milky-white on fresh fracture; hard and brittle at ordinary temperatures, but softened by heat and becoming gritty on chewing; odor aromatic and upon digesting with boiling water, suggesting the odor of cinnamic acid or storax; taste aromatic and slightly acrid.

Siam Benzoin.—In pebble-like tears of variable size, compressed, yellowish-brown to rusty-brown externally, milky-white on fracture, separate or very slightly agglutinated; hard and brittle at ordinary temperatures but

softened by heat and becoming plastic on chewing; odor agreeable, balsamic, vanilla-like; taste slightly acrid. *Solubility.*—Not less than 75 per cent. of Sumatra, and not less than 90 per cent. of Siam Benzoin dissolves in Alcohol; the alcoholic solution, upon the addition of water, becomes milky and is acid to litmus.

COMPOSITION.—The chief constituents are—(1) *Benzoic Acid* (*see* below), 12 to 20 per cent. (2) *Cinnamic Acid*, $C_9H_8O_2$, a trace. (3) Resin. (4) Volatile Oil.

Dose, 1 gm. (15 gr.).

Preparations

1. **Adeps Benzoinatus.**—Benzoinated Lard, Abv.—Adeps. Benz. Siam Benzoin, 10; Lard, 1000; by melting and straining.

2. **Tinctura Benzoini.**—Tincture of Benzoin. Abv.—Tr. Benz. Benzoin, 200; by maceration and filtration with Alcohol to 1000.
Dose, 1 mil (15 ♏).

3. **Tinctura Benzoini Composita.**—Compound Tincture of Benzoin. Abv.—Tr. Benz. Co. *Synonym.*—Friar's Balsam. Benzoin, 100; Storax, 80; Balsam of Tolu, 40; Aloes, 20; by digestion with Alcohol, and filtration to 1000.
Dose, 2 mils (30 ♏).

ACIDUM BENZOICUM.—Benzoic Acid. Abv.—Ac. Benz. $C_7H_6O_2 = 122.05$. An organic acid ($C_6H_5 \cdot COOH$) obtained from Benzoin or prepared synthetically. It contains when dried to a constant weight not less than 99.5 per cent. of Benzoic Acid ($C_6H_5 \cdot COOH$)

CHARACTERS.—In lustrous scales or friable needles. The synthetic Acid is white, odorless, or with a slight odor of Benzaldehyde; the natural Acid is white or yellowish, acquires a darker color on exposure to light, and has a slight odor of Benzoin. Benzoic Acid has a pungent taste, is somewhat volatile at moderately warm temperatures and freely volatile with steam. *Solubility.*—In 275 parts of water and 18 of boiling water; in 2.3 parts of Alcohol, 3 of Ether, and 4.5 of Chloroform; also in fixed or volatile oils.

IMPURITIES.—Chlorine, cinnamic acid, readily carbonizable organic matters.
Dose, 0.500 gm. = 500 milligm. (8 gr.).
Benzoic Acid is contained in Tinctura Opii Camphorata.

AMMONII BENZOAS.—Ammonium Benzoate. Abv.—Ammon. Benz. $NH_4C_7H_5O_2 = 139.08$. It contains not less than 98 per cent. of Ammonium Benzoate ($C_6H_5 \cdot COONH_4$).

SOURCE.—Dissolve Benzoic Acid in Water of Ammonia and distilled water, and evaporate, set aside to crystallize. $HC_7H_5O_2 + NH_4OH = NH_4C_7H_5O_2 + H_2O$.

CHARACTERS.—Thin, white, laminar crystals or a crystalline powder, gradually losing ammonia on exposure to air; odorless or having a slight odor of Benzoic Acid, a saline, bitter, afterwards slightly acrid taste. *Solubility.*—In about 10 parts of water and 35.5 of Alcohol, in about 8 parts of Glycerin.

IMPURITIES.—Heavy metals, and those of benzoic acid.

INCOMPATIBLES.—Ferric salts, acids, solution of potassium hydroxide.

Dose, 1 gm. (15 gr.).

SODII BENZOAS.—Sodium Benzoate. Abv.—Sod. Benz. $NaC_7H_5O_2$ = 144.04. It should contain not less than 99 per cent. of Sodium Benzoate (C_6H_5·COONa).

SOURCE.—Benzoic Acid is added to a hot concentrated solution of pure Sodium Carbonate, the solution is evaporated, cooled and allowed to crystallize. $2HC_7H_5O_2 + NaCO_3 = 2NaC_7H_5O_2 + CO_2 + H_2O$.

CHARACTERS.—A white, amorphous, granular or crystalline powder, odorless and having a sweetish taste; permanent in the air. *Solubility.*—In 1.8 parts of water, in 61 of Alcohol, and in 1.4 parts of boiling water.

IMPURITIES.—Heavy metals and those of benzoic acid.

INCOMPATIBLES.—Ferric salts, acids.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Benzoin, Benzoic Acid and the Benzoates *see* p. 575.

GROUP VII.—Drugs Acting on Unstriped Muscle (Especially That of the Uterus)

Ergot, Hydrastis, Parsley Fruit, Cimicifuga, Viburnum

ERGOTA

ERGOT. *Synonyms.*—Ergot of Rye. Spurred Rye. The carefully dried sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fam. *Hypocreaceæ*), replacing the grain of rye, *Secale cereale* Linné (Fam. *Gramineæ*), without the presence or admixture of more than .5 per cent. of seeds, fruits or other foreign matter. *Habitat.*—Spain and Russia.

CHARACTERS.—Cylindraceous, obscurely three-angled, tapering towards both ends, obtuse, somewhat curved, from 1 to 4.5 cm. in length and from 3 to 5 mm. in thickness; externally purplish-black or brownish-black, longitudinally furrowed; fracture short, pinkish or reddish-white, sometimes grayish-white; odor peculiar, disagreeable, free from mustiness; taste oily and disagreeable.

COMPOSITION.—This has been in dispute, but from recent and probably reliable investigations the chief constituents are—(1) *Ergotoxine* or hydrated Ergotine, $C_{50}H_{52}N_2O_8$, an amorphous alkaloid, bitter; soluble in Alcohol but insoluble in water. *Tryamine* (*Para-hydroxyl-phenyl-ethylamine*), an amorphous alkaloid, soluble in water and Alcohol. (3) *Ergotine*, and (4) *Isoamyline*, which are unimportant. (5) *Ergotinic Acid.* (6) Choline. (7) A fixed oil, 30 per cent. (8) Various Saponins. (9) Tannic Acid.

Dose, 2 gm. (30 gr.).

Preparations

1. **Extractum Ergotæ.**—Extract of Ergot. Abv.—Ext. Ergot. *Synonym.*—Ergotin. Ergot, 1000; Hydrochloric Acid, 10; Purified Petro-

leum Benzin, Alcohol and water, each, a sufficient quantity. By percolation with Purified Petroleum Benzin. The percolate is rejected, the Ergot is dried by exposure to the air. Mix 850 mils of Alcohol with 150 mils of water, add the Hydrochloric Acid, macerate and percolate; distil off the Alcohol, evaporate the residue to pilular consistence.

INCOMPATIBLES.—Astringents, metallic salts in solution.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. Fluidextractum Ergotæ.—Fluidextract of Ergot. Abv.—Fldext. Ergot. By maceration and percolation with Hydrochloric Acid and Diluted Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

For the Therapeutics of Ergot *see* p. 795.

HYDRASTIS

HYDRASTIS. *Synonyms.*—Golden Seal. Yellow Puccoon. The dried rhizome and roots of *Hydrastis canadensis* Linné (Fam. *Ranunculaceæ*), without the presence or admixture of more than 2 per cent. of the stems, leaves or other foreign matter. It should yield not less than 2.5 per cent. of the ether soluble alkaloids of Hydrastis. *Habitat.*—North America, west to Missouri and Arkansas, in woodlands.

CHARACTERS.—Rhizome horizontal or oblique, subcylindrical and usually more or less flexuous, from 1 to 5 cm. in length, and from 2 to 7 mm. in diameter, occasionally with stem-bases; externally yellowish or grayish-brown, marked by numerous stem-scars and more or less annulate from scars of bud-scales, otherwise deeply longitudinally wrinkled; on the under and lateral portions arise numerous, long, filiform roots which are easily detached; fracture short, waxy; internally of a deep yellow color and consisting mostly of parenchyma enclosing an interrupted circle in small fibro-vascular bundles; odor distinctive; taste bitter.

COMPOSITION.—It contains—(1) *Berberine*, $C_{20}H_{17}O_4N$, an alkaloid existing as yellowish prismatic crystals, which is formed in many plants (Calumba, Xanthoxylum, etc.), chiefly in the families *Menispermaceæ*, and *Ranunculaceæ*. (2) *Hydrastine* (*see* p. 178). (3) *Canadine*, $C_{21}H_{21}NO_4$, in white needles.

Dose, 2 gm. (30 gr.).

Preparations

1. Extractum Hydrastis.—Extract of Hydrastis. Abv.—Ext. Hydrast. *Synonym.*—Extract of Golden Seal. It yields not less than 9 per cent. nor more than 11 per cent. of the ether-soluble alkaloids of Hydrastis. By maceration and percolation with Tartaric Acid, 5; in Alcohol, 1,000; distillation of the Alcohol, evaporation, addition of Magnesium Oxide (1 part) Starch (3 parts), 50; and drying.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

2. Fluidextractum Hydrastis.—Fluidextract of Hydrastis. Abv.—Fldext. Hydrast. It contains not less than 1.8 per cent. nor more than 2.2 per cent. of the ether-soluble alkaloids of Hydrastis. By maceration and percolation with Alcohol, Glycerin and water, and evaporation.

Dose, 2 mils (30 ♏).

3. Glyceritum Hydrastis.—Glycerite of Hydrastis. It should yield not less than 1.12 per cent. nor more than 1.37 per cent. of the ether-soluble alkaloids of Hydrastis. Hydrastis, by percolation and maceration with Alcohol; distil off the Alcohol, add ice-cold water, filter, and to the filtrate add an equal volume of Glycerin.

Dose, 2 mils (30 ♏).

4. Tinctura Hydrastis.—Tincture of Hydrastis. Abv.—Tr. Hydrast. It yields not less than 0.36 per cent. nor more than 0.44 per cent. of the ether-soluble alkaloids of Hydrastis. Hydrastis, 200, by maceration and percolation with Alcohol and water to 1000.

Dose, 4 mils (1 fl. dr.).

HYDRASTINA.—Hydrastine. $C_{21}H_{21}O_6N = 383.18$. An alkaloid obtained from Hydrastis, or prepared synthetically.

CHARACTERS.—White to creamy white, glistening prisms, or as a white microcrystalline powder; permanent in the air. *Solubility.*—Almost insoluble in water; soluble in 170 parts of Alcohol, 175 of Ether, and 1.4 of Chloroform at 25°C. (77°F.); and soluble in 22 parts of Alcohol at 60°C. (140°F.); freely soluble in Benzene.

IMPURITY.—Hydrastinine.

Dose, 0.010 gm. = 10 milligm. (⅙ gr.).

HYDRASTINÆ HYDROCHLORIDUM.—Hydrastine Hydrochloride. Abv.—Hydrastin. Hydrochlor. $C_{21}H_{21}O_6N \cdot HCl = 419.65$. The hydrochloride of the alkaloid Hydrastine.

SOURCE.—By action of Hydrochloric Acid upon the alkaloid Hydrastine.

CHARACTERS.—A white creamy-white powder, odorless, and hygroscopic. *Solubility.*—Very soluble in water and in Alcohol; slightly soluble in Chloroform; very slightly soluble in Ether.

Dose, 0.01 gm. = 10 milligm. (⅙ gr.).

HYDRASTININÆ HYDROCHLORIDIUM.—Hydrastinine Hydrochloride. Abr.—Hydrastinin. Hydrochlor. $C_{11}H_{11}O_6N \cdot HCl = 225.57$. The Hydrochloride of Hydrastinine, an alkaloid obtained by the oxidation of Hydrastine.

SOURCE.—By acting upon Hydrastine by oxidizing agents, as when Manganese Dioxide and Sulphuric Acid are used together, or when Platinic Chloride is employed.

CHARACTERS.—Light yellowish needles, or a yellowish-white crystalline powder without odor. *Solubility.*—Very soluble in water and Alcohol; in 195 parts of Chloroform and 1820 of Ether, at 25°C. (77°F.)

Dose, 0.030 gm. = 30 milligm. (½ gr.).

For the Therapeutics of Hydrastis *see* p. 799.

PETROSELINUM

PARSLEY FRUIT. Abv.—Petrosel. *Synonym.*—Parsley Seed. The dried ripe fruit of *Petroselinum Sativum* Hoffman (Fam. *Umbelliferæ*), without the presence or admixture of more than 5 per cent. of foreign seeds or other matter. *Habitat.*—Southern Europe.

CHARACTERS.—Mericarps usually separated, ovoid-crescent shaped, from 2 to 3 mm. in length and about 1 mm. in diameter; externally grayish-brown, becoming grayish or brownish on aging, having 5 yellowish, filiform, prominent ribs, alternating with the coarsely roughened furrows; in transverse section nearly hemispherical, the commisural surface with 2 vittæ or oil-tubes, the dorsal surface usually with a single vitta; occasionally 2 vittæ in the grooves between the primary ribs; endosperm large, oily, enclosing a small embryo; odor and taste characteristic and aromatic, especially when bruised.

COMPOSITION.—The chief constituents are—(1) *Apiol* associated with a terpene. (2) *A volatile oil* 5 or 6 per cent. (3) Probably Pinene. (4) Starch and Mucilage.

Preparation

Oleoresina Petroselini.—Oleoresin of Parsley Fruit. Abv.—Oleores. Petrosel. *Synonym.*—Liquid Apiol. By percolation with Ether, distillation of the Ether and decantation.

Dosè, 0.5 mil (8 ♏).

For the Therapeutics of Parsley Fruit *see* p. 801 .

CIMICIFUGA

CIMICIFUGA. Abv.—Cimicif. *Synonyms.*—Black Snakeroot. Black Co hosh. Macrotys. The dried rhizome and roots of *Cimicifuga racemosa* (Linné-Nuttall (Fam. *Ranunculacæ*), without the presence or admixture of more than 2 per cent. of stems or foreign matter. *Habitat.*—North America; in rich woodlands, westward to Eastern Kansas.

CHARACTERS.—Rhizome horizontal, more or less branching, from 2 to 12 cm. in length, and from 1 to 2.5 cm. in thickness; externally dark brown, slightly annulate from circular scars of bud scale-leaves, the upper surface with numerous stout, erect or somewhat curved branches terminated by deep cup-shaped scars, each of which usually shows a distinct radiate structure; inferior and lateral portions with numerous root-scars and a few short roots; fracture horny, internally whitish and mealy or dark brown and waxy, bark thin, wood distinctly radiate and about of the same thickness as the pith; odor slight; taste bitter and acrid. Roots somewhat cylindrical or obtusely quadrangular, from 1 to 3 mm. in thickness, externally dark brown, longitudinally wrinkled; fracture short; internally bark dark brown, wood yellowish, 4- to 6-rayed.

COMPOSITION.—The chief constituents are—(1) An acrid, crystalline principle, soluble in Chloroform and Alcohol. (2) Tannic and Gallic Acids. (3) Two Resins. *Cimicifugin* or *Macrotin* is an impure resin deposited from the percolated alcoholic solution on adding water.

Dose, 1 gm. (15 gr.).

Preparations

1. **Extractum Cimicifugæ.**—Extract of Cimicifuga. Abv.—Ext. Cimicif. By maceration and percolation with alcohol and evaporation.
Dose, 0..250 gm. = 250 milligm. (4 gr.).

2. **Fluidextractum Cimicifugæ.**—Fluidextract of Cimicifuga. Abv.—Fldext. Cimicif. By maceration and percolation with Alcohol, and evaporation.
Dose, 1 mil. (15 ♏).

For the Therapeutics of Cimicifuga *see* p. 801.

VIBURNUM PRUNIFOLIUM

VIBURNUM PRUNIFOLIUM. Abv.—Viburn. Prun. *Synonyms.*—Viburnum. Black Haw. The dried bark of the root of *Viburnum prunifolium* Linné, or of *Viburnum Lentago* Linné (Fam. *Caprifoliaceæ*) without the presence or admixture of more than 5 per cent. of wood or other foreign matter. *Habitat.*—United States, westward to Kansas and Mississippi; in thickets.

CHARACTERS.—In irregular, transversely curved or quilled pieces, from 1.5 to 6 cm. in length, and from 0.5 to 1.5 mm. in thickness; outer surface grayish-brown, or, when the outer cork has scaled off, brownish-red, longitudinally wrinkled; inner surface reddish-brown, longitudinally striated; fracture short but uneven, showing in bark which is young or of medium thickness, a dark brown cork, a brownish-red outer cortex, and a whitish inner cortex in which are numerous light yellow groups of sclerenchymatous tissues; odor slight; taste distinctly bitter and somewhat astringent.

COMPOSITION.—Its chief constituents are—(1) A brown, bitter Resin. (2) *Viburnin*, a greenish-yellow, bitter principle. (3) *Valeric Acid* (*see* p. 190). (4) Tannic Acid. (5) Oxalates, Citrates and Malates.
Dose, 2 gm. (30 gr.).

Preparations

1. **Extractum Viburni Prunifolii.**—Extract of Viburnum Prunifolium. Abv.—Ext. Vibur. Prun. By maceration and percolation with diluted Alcohol, distillation of the Alcohol, addition of Magnesium Oxide and Starch, evaporation and drying.
Dose, 0.5 gm. = 500 milligm. (8 gr.).

2. **Fluidextractum Viburni Prunifolii.**—Fluidextract of Viburnum Prunifolium. Abv.—Fluidext. Viburn. Prun. By maceration and percolation with Alcohol and Water, and evaporation.
Dose, 2 mils (30 ♏).

For the Therapeutics of Viburnum Prunifolium *see* p. 802.

GROUP VIII.—The Vegetable Bitters

Calumba, Gentian, Quassia, Serpentaria, Taraxacum, Orange Peel, Lemon Peel

CALUMBA. Abv.—Calumb. *Synonyms.*—Columbo. Colombo. The dried root of *Jateorhiza palmata* (Lamarck) Miers (Fam. *Menispermaceæ*). *Habitat.*—Eastern Africa; cultivated in some East Indian Islands.

CHARACTERS.—In circular or oval disks attaining a diameter of 9 cm. and seldom exceeding 2 mm. in thickness, or in longitudinal or in oblique slices attaining a length of 30 cm., a breadth of 35 mm. and a thickness of 16 mm.; externally brown and roughly wrinkled; cut surface varying from yellowish-brown to grayish-yellow, the transverse slices distinctly radiate in the outer portion and with a dark cambium; central portion often depressed; fracture short, mealy; odor slight; taste slightly aromatic, very bitter.

COMPOSITION.—The chief constituents are—(1) *Calumbin*, $C_{21}H_{22}O_7$, a neutral, bitter principle crystallizing in white needles. (2) *Berberine* ($C_{20}H_{17}O_4N$), an alkaloid, giving the yellow color (*see* p. 177). (3) *Calumbic Acid*, $C_{21}H_{22}O_6$. (4) Starch, 33 per cent. No Tannic Acid is present, so Calumba can be prescribed with iron salts.

INCOMPATIBLES.—Ammonia, lead acetate, mineral acids, silver nitrate, tartar emetic.

Dose, 2 gm. (30 gr.).

Preparation

Tinctura Calumbæ.—Tincture of Calumba. Abv.—Tr. Calumb. Calumba, 200, by maceration and percolation with Alcohol and water to 1000.

Dose, 4 mils. (1 fl. dr.)

For the Therapeutics of Calumba *see* p. 630.

GENTIANA

GENTIAN.—*Synonym.*—The dried rhizome and roots of *Gentiana lutea* Linné (Fam. *Gentianaceæ*). *Habitat.*—Mountains of Central and Southern Europe.

CHARACTERS.—In nearly cylindrical, sometimes branching pieces, of variable length, from 5 to 35 mm. in thickness; externally yellowish-brown, the rhizome portion annulate, the roots longitudinally wrinkled; fracture short and uneven when dry, but tough and flexible when damp; internally yellowish-brown, the bark from 0.5 to 2 mm. in thickness, separated from the somewhat spongy, woody portion by a dark brown cambium zone; odor strong, characteristic; taste slightly sweetish, then strongly and persistently bitter.

COMPOSITION.—The chief constituents are—(1) *Gentiopicrin*, an active, very bitter glucoside, soluble in water and Alcohol. Can be split up into glucose and *Gentiogenin*. (2) *Gentisic Acid*, $C_{14}H_{10}O_6$, in yellow, tasteless needles, united with *Gentiopicrin*. (3) A trace of a volatile oil. (4) Gentianose, a sugar. Gentian contains no Tannic Acid, but cannot be prescribed with iron, because that darkens the coloring matter.

INCOMPATIBLES.—Iron salts, silver nitrate, lead salts.
Dose, 1 gm. (15 gr.).

Preparations

1. **Extractum Gentinæ.**—Extract of Gentian. Abv.—Ext. Gentian. By maceration and percolation with water, and evaporation.
Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. **Fluidextractum Gentianæ.**—Fluidextract of Gentian. Abv. Fldext. Gentian. By maceration and percolation with Diluted Alcohol, and evaporation.
Dose, 1 mil. (15 ♏).

3. **Tinctura Gentianæ Composita.**—Compound Tincture of Gentian. Abv.—Tr. Gentian Co. Gentian, 100; Bitter Orange Peel, 40; Cardamom Seed 10. By maceration and percolation with diluted Alcohol, Glycerin and water to 1000.
Dose, 4 mils. (1 fl. dr.).

For the Therapeutics of Gentian *see* p. 631.

QUASSIA

QUASSIA. Abv.—Quass. *Synonym.*—Bitter wood.—The wood of *Picrasma excelsa* (Swartz) Planchon (Fam. *Simarubaceæ*), known in commerce as *Jamaica Quassia*, or of *Quassia amara* Linné (Fam. *Simarubaceæ*), known in commerce as *Surinam Quassia*. *Habitat.*—Jamaica; Dutch Guiana, South America.

CHARACTERS. *Picrasma Excelsa.*—Usually in chips, raspings, or shavings, occasionally in small cubes or billets; yellowish-white or bright yellow, with a few light gray pieces somewhat coarsely grained; fracture tough, fibrous; odor slight; taste bitter.

Quassia Amara.—Closely resembling the *Jamaica* variety, tracheæ usually single or in pairs, sometimes in groups of 3 or 4; medullary rays in narrower and larger groups than in the Jamaica variety, from 1 to 4 cells wide and from 10 to 30 rows deep; calcium oxalate crystals few or entirely absent, thus distinguishing this variety from Jamaica Quassia.

Resembling Quassia.—Sassafras, but this is aromatic and not bitter.

COMPOSITION.—The chief constituents are—(1) *Quassiin*, $C_{10}H_{12}O_3$, a bitter principle occurring in crystalline rectangular plates. (2) A volatile oil. No Tannic Acid being present, Quassia can be prescribed with iron salts.
Dose, 0.5 gm. = 500 milligm. (8 gr.).

Preparations

Tinctura Quassiæ.—Tincture of Quassia. Abv.—Tr. Quass. Quassia, 200; by maceration and percolation with Alcohol and water to 1000.
Dose, 2 mils. (30 ♏).

or the Therapeutics of Quassia *see* p. 632.

SERPENTARIA

SERPENTARIA. Abv.—Serpent. *Synonyms.*—Virginia Snakeroot. Texas Snakeroot. The dried rhizome and roots of *Aristolochia Serpentaria* Linné, known in commerce as Virginia Snakeroot, or of *Aristolochia reticulata* Nuttall, known in commerce as Texas Snakeroot (Fam. *Aristolochiaceæ*), without the presence or admixture of more than 10 per cent. of the stems or other foreign matter. *Habitat.*—United States, in hilly woods.

CHARACTERS.—Rhizome in both varieties oblique, subcylindrical, more or less curved from 10 to 30 mm. in length and from 1 to 2 mm. in diameter; externally dark brown, upper portion with short stem-bases and from lower and lateral portions arise numerous long, thin, nearly straight, yellowish-brown roots; fracture short; internally yellowish-white, wood with broad, eccentric wedges; odor terebinthinate; taste bitter and aromatic.

Resembling Serpentaria.—Veratrum, Arnica and Valerian.

COMPOSITION.—The chief constituents are—(1) A bitter principle, *Aristolochin* in light-yellow needles. (2) A volatile oil, containing a terpene, and mainly $C_{15}H_{28}O_2$, Borneol Ether. (3) Resin. (4) Tannic Acid in small quantity.

Dose, 1 gm. (15 gr.).

Serpentaria is contained in Tinctura Cinchonæ Composita.

For the Therapeutics of Serpentaria *see* p. 632.

TARAXACUM

TARAXACUM. Abv.—Tarax. *Synonym.*—Dandelion. The dried rhizome and roots of *Taraxacum officinale* Weber (Fam. *Compositæ*). *Habitat.*—Grassy places and roadsides in Europe; naturalized in the United States.

CHARACTERS.—Cylindrical or somewhat flattened, gradually tapering, usually in broken pieces, from 6 to 15 cm. in length and from 5 to 15 mm. in thickness; externally brown or blackish-brown, longitudinally wrinkled, having numerous root and rootlet-scars; crown smiple or branched with numerous leaf-bases showing annulate markings; odor slight or inodorous; taste bitter. *Resembling Taraxacum.*—Pellitory, which is pungent when chewed.

COMPOSITION.—The chief constituents are—(1) *Taraxacin*, a crystalline bitter principle, soluble in water and Alcohol. (2) *Taraxacerin*, $C_8H_{16}O$. (3) Asparagin (found in marsh-mallow and licorice) of no therapeutic value. (4) Inulin. (5) Resin (which gives the juice its milky appearance).

IMPURITY.—The root of the *Chicorium Intybus*, which is paler, and has the milk vessels in radiating lines.

Dose, 10 gm. (2½ gr.).

Preparations

1. **Extractum Taraxaci.**—Extract of Taraxacum. Abv.—Ext. Tarax. By percolation and maceration with Alcohol and water, and evaporation.

Dose, 1 gm. (15 gr.).

2. Fluidextractum Taraxaci.—Fluidextract of Taraxacum. Abv.—Fldext. Tarax. By maceration and percolation with Glycerin, Alcohol, and water.

Dose, 10 mils (2½ fl. dr.).

For the Therapeutics of Taraxacum *see* p. 632.

AURANTIUS

AURANTII AMARI CORTEX.—Bitter Orange Peel. Abv.—Aurant. Amar. Cort. The dried rind of the fruit of *Citrus Aurantium Amara* Linné (Fam. *Rutaceæ*). *Habitat.*—Northern India; cultivated in subtropical countries.

CHARACTERS.—In narrow, thin bands (ribbons), or more often elliptical, flattened, more or less curved, pieces (quarters) varying from 3 to 6 cm. in length; outer surface convex, varying from reddish- to yellowish-brown (ribbons) to greenish-brown (quarters), coarsely reticulate and with the edges recurved; inner surface concave, whitish, with numerous conical projections and yellowish-white, linear more or less anastomosing fibro-vascular bundles; fracture hard; transverse section light brown, somewhat spongy, outer layer with 1 or 2 rows of oil reservoirs; odor fragrant; taste aromatic and bitter.

COMPOSITION.—The chief constituents are—(1) A volatile oil, consisting mainly of *Hesperidene*, $C_{10}H_{16}$, with a small portion of *Geraniol*, $C_{10}H_{16}O$. (2) Three glucosides, *Hesperidin*, *Isohesperidin* and *Aurantiamarin*, the bitter principle. Both Bitter and Sweet Orange Peel contain a substance which reacts with iron salts and Tannic Acid.

Dose, 1 gm. (15 gr.)

Bitter Orange Peel is used in preparing Tinctura Cinchonæ Composita and Tinctura Gentianæ Composita.

Preparations

1. Fluidextractum Aurantii Amari.—Fluidextract of Bitter Orange Peel. Abv.—Fldext. Aurant. Amar. By maceration and percolation with Alcohol and water, and evaporation.

Dose, 1 mil (15 ♏).

2. Tinctura Aurantii Amari.—Tincture of Bitter Orange Peel. Bitter Orange Peel, 200. By maceration and percolation with Alcohol and water to 1000.

Dose, 4 mils (1 fl. dr.).

AURANTII DULCIS CORTEX.—Sweet Orange Peel. Abv.—Aurant. Dulc. Cort. The outer rind of the fresh, ripe fruit of *Citrus Aurantium sinensis* Gallesio (Fam. *Rutaceæ*). *Habitat.*—Northern India; cultivated in tropical countries.

CHARACTERS.—The outer orange-yellow layer recently separated by grating or paring and consisting of epidermal cells, parenchyma cells of the sarcocarp with chromoplastids, oil reservoirs and globules of volatile oil; odor highly fragrant; taste pungently aromatic.

COMPOSITION.—As of the Bitter Orange Peel.

Preparations

1. **Syrupus Aurantii.**—Syrup of Orange. Abv.—Syr. Aurant. Tincture of Sweet Orange Peel, 50; Citric Acid, 5; Purified Talc., 15; Sugar, 820; Distilled water to 1000. By trituration and filtration.

2. **Tinctura Aurantii Dulcis.**—Tincture of Sweet Orange Peel. Abv.—Tr. Aurant. Dulc. Sweet Orange Peel, 500. By maceration and percolation with Alcohol to 1000.

Dose, 4 mils (1 fl. dr.).

OLEUM AURANTII.—Oil of Orange. Abv.—Ol. Aurant. *Synonym.*—Oil of Sweet Orange. A volatile oil obtained by expression from the fresh peel of Sweet Orange, *Citrus Aurantium sinensis* Gallesio (Fam. *Rutaceæ*) and its varieties.

CHARACTERS.—A yellow liquid, having the characteristic odor and taste of Orange Peel. Sp. gr., 0.842 to 0.846 at 25°C. (77°F.).

COMPOSITION.—The chief constituents are (1) *Limonene*, about 90 per cent., (2) Odorous substances as *Citral* and *Citronellal*, aldehydes.

IMPURITIES.—Oil of Turpentine, alcohol.

Dose, 0.2 mil (3 ♏).

Preparations

1. **Spiritus Aurantii Compositus.**—Compound Spirit of Orange. Abv.—Sp. Aur. Co. Oil of Orange, 200; Oil of Lemon, 50; Oil of Coriander, 20; Oil of Anise, 5; Alcohol to 1000.

2. **Elixir Aromaticum.**—Aromatic Elixir. Abv.—Elix. Arom. *Synonym.*—Simple Elixir. Compound Spirit of Orange, 12; Syrup, 375; Purified Talc, 30; Alcohol, Distilled water, each, a sufficient quantity to make 1000. By solution of the Compound Spirit of Orange in Alcohol, to 250; addition of Syrup and Purified Talc, and filtering, with Distilled water to 1000.

Aromatic Elixir is used in Elixir Glycyrrhizæ and Liquor Ferri et Ammonii Acetatis.

Preparations of the Volatile Oil of Fresh Orange Flowers.

1. **Aqua Aurantii Florum.**—Orange Flower Water. Abv.—Aq. Aurant. Flor. Stronger Orange Flower Water, Distilled Water, each, one volume.

Orange Flower Water is contained in Syrupus Lactucarii.

2. **Aqua Aurantii Florum Fortior.**—Stronger Orange Flower Water. Abv.—Aq. Aurant. Flor. Fort. The saturated aqueous distillate prepared by distilling the fresh flowers of *Citrus Aurantium amara* Linné (Fam. *Rutaceæ*) with water.

IMPURITY.—Metallic matters.

Stronger Orange Flower Water is contained in Trochisci Acidi Tannici and Syrupus Calcii Lactophosphatis.

3. Syrupus Aurantii Florum.—Syrup of Orange Flowers. Abv.—Syr. Aurant Flor. Sugar, 850; Orange Flower Water, by percolation to 1000.

For the Therapeutics of Orange *see* p. 639.

LIMON

LIMONIS CORTEX.—Lemon Peel. Abv.—Limon. Cort. The outer rind of the fresh ripe fruit of *Citrus medica Limonum* (Risso) Hooker filius (Fam. *Rutaceæ*). *Habitat.*—Northern India; cultivated in subtropical countries.

CHARACTERS.—The outer, lemon-yellow or dark-yellow layer, recently separated by grating or paring and consisting of an epidermal layer, numerous parenchyma cells containing yellow chromoplastids, and large oil reservoirs with globules of the volatile oil; odor highly fragrant, distinctive; taste pungent, aromatic.

COMPOSITION.—The chief constituents are—(1) the official oil, $C_{10}H_{16}$ (*see* below). (2) *Hesperidin*, $C_{28}H_{34}O_{15}$, a bitter principle.

Preparation

Tinctura Limonis Corticis.—Tincture of Lemon Peel. Abv.—Tr. Limon. Cort. Lemon Peel, 500; Alcohol, to 1000. By maceration and filtration.

Tincture of Lemon Peel is contained in Syrupus Acidi Citrici.

OLEUM LIMONIS.—Oil of Lemon. Abv.—Ol. Limon. A volatile oil obtained by expression from the fresh peel of the ripe fruit of *Citrus medica Limonum* (Risso) Hooker filius (Fam. *Rutaceæ*), yielding not less than 4 per cent. of aldehyde from Oil of Lemon calculated as Citral ($C_{10}H_{16}O = 152.13$). Oil of Lemon having a terebinthinate odor is not to be dispensed.

CHARACTERS.—A pale yellow, or greenish-yellow liquid, having the characteristic odor and taste of Lemon. Sp. gr., 0.851 to 0.855 at 25°C. (77°F.).

COMPOSITION.—The chief constituents are—(1) A terpene called *Citrene*, or *Limonene*, $C_{10}H_{16}$, 90 per cent., strongly dextro-rotatory. This is also found in Oil of Caraway (*see* p. 210). (2) *Citral*, $C_{10}H_{16}O$, an aldehyde found also in Oil of Orange (*see* p. 185). (3) *Citronellal*, an aldehyde.

Dose, 0.2 mil (3 ♏).

Oil of Lemon is contained in Spiritus Ammoniæ Aromaticus and Spiritus Aurantii Compositus.

For the Therapeutics of Lemon *see* p. 639.

GROUP IX.—Drugs Containing Tannic Acid

Nutgall, Tannic Acid, Gallic Acid, Pyrogallol, Gambir, Kino, Hamamelis

GALLA.—Nutgall. Abv.—Gall. *Synonyms.*—Aleppo Galls. Smyrna Galls. Excresences on the young twigs of *Quercus infectoria* Olivier and other allied species of Quercus (Fam. *Fagaceæ*), induced by the punctures on the leaf-buds

and by the deposited ova of *Cynips tinctoria* Hartig (Order *Hymenopteræ*). *Habitat.*—Levant.

CHARACTERS.—Nearly globular, from 0.8 to 2.2 cm. in diameter; externally blackish olive-green or blackish-gray, more or less tuberculated on the upper portion, the basal portion being nearly smooth and contracted into a short stalk; heavy, sinking in water, excepting the smaller galls; fracture horny; internally grayish or dark brown, consisting of a central portion slightly radiating and resinous, occasionally hollow and transversed by a narrow radial canal extending to the exterior as shown by the perforation in the whole gall; odor slight; taste strongly astringent.

COMPOSITION.—The chief constituents are—(1) *Tannic Acid*, 50 to 60 per cent. (2) *Gallic Acid*, 2 to 3 per cent. (3) Sugar. (4) Resin.

INCOMPATIBLES.—*See* Tannic and Gallic Acids, pp. 187 and 188.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Unguentum Gallæ.—Nutgall Ointment. Abv.—Ung. Gall. Nutgall, 20; Ointment, 80.

ACIDUM TANNICUM.—Tannic Acid. Abv.—Acid. Tann. *Synonyms.*—Tannin. Gallotannic Acid. Digallic Acid. Variable, $HC_{14}H_9O_9 = 322.08$. A Tannin ($C_{13}H_9O_7COOH$), usually obtained from Nutgalls.

SOURCE.—(1) Expose powdered Nutgall to a damp atmosphere for twenty-four hours. (2) Add Ether to form a paste, and let it stand, closely covered, for six hours. (3) Express this in a close canvas cloth, between tinned plates, reduce the resulting cake to powder and mix with sufficient Ether and express as before. (4) Mix the expressed liquids and allow the mixture to evaporate spontaneously. Tannic Acid remains. $2HC_7H_5O_5 - H_2O = HC_{14}H_9O_9$.

CHARACTERS.—A yellowish-white to light brown, amorphous powder, gradually turning darker when exposed to air and light, usually cohering in the form of glistening scales or spongy masses; odorless, or having a faint, characteristic odor, and a strongly astringent taste. *Solubility.*—Very soluble in water and Alcohol at 25°C. (77°F.); in boiling water, and boiling Alcohol; also dissolves in 1 part of Glycerin, with the application of a moderate heat; freely soluble in Diluted Alcohol, sparingly in Dehydrated Alcohol; almost insoluble in Ether, Chloroform, Benzene or Petroleum Benzin.

IMPURITIES.—Gallic acid, gum, dextrin, resinous substances.

INCOMPATIBLES.—Mineral acids, albumin, alkaloids, amyl nitrite, antipyrine, arsenic, salts of antimony, chromium, copper, iron, lead, mercury and silver, emulsions, gelatin, iodine, iodoform, lime water, starch, spirit of nitrous ether, chlorates, permanganates and other oxidizers.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparations

1. **Glyceritum Acidi Tannici.**—Glycerite of Tannic Acid. Abv.—Glycer. Acid. Tann. Tannic Acid, 20; Glycerin, 80.

Dose, 2 mils (30 ♏).

2. **Trochisci Acidi Tannici.**—Troches of Tannic Acid. Abv.—Troch. Acid. Tann. Tannic Acid, 6; Sugar, 65; Tragacanth, 2 gm.; Stronger Orange Flower Water, a sufficient quantity to make 100 troches. Each troche contains about 0.06 gm.; 1 gr., of Tannic Acid.

3. **Unguentum Acidi Tannici.**—Ointment of Tannic Acid. Abv.—Ung. Acid. Tann. Tannic Acid, 20; Glycerin, 20; Ointment, 60.

For the Therapeutics of Tannic Acid *see* p. 506.

ACIDUM GALLICUM.—Gallic Acid. Abv.—Acid. Gallic. $C_7H_6O_5+H_2O$ = 188.06. An organic acid [$C_6H_2(OH)_3COOH.1:3:4:5+H_2O$], usually prepared from Tannic Acid.

SOURCE.—Boil 1 part of Tannic Acid (or 2 parts of coarsely powdered Nutgall) with 1 part of Sulphuric Acid and 5 parts of water, for 15 minutes; strain the mixture while hot, and set the liquid aside so that crystals may form; these are then deprived of color by resolution in water and filtration through animal charcoal. The filtrate is set aside again to crystallize, and if necessary, the treatment with charcoal is repeated.

CHARACTERS.—White, or pale fawn-colored, silky, interlaced needles, or triclinic prisms; odorless; having an astringent and slightly acidulous taste; permanent in the air. *Solubility.*—In 87 parts of water, and in 3 of boiling water; in 4.6 parts of Alcohol; also in about 100 parts of Ether, and in 10 parts of Glycerin; almost insoluble in Chloroform.

IMPURITY.—Tannic Acid.

INCOMPATIBLES.—Ferric and metallic salts generally, iodine, lime water, opium in solution, spirit of nitrous ether.

Dose, 1 gm. (15 gr.).

For the Therapeutics of Gallic Acid *see* p. 509.

PYROGALLOL

PYROGALLOL. Abv.—Pyrogall. Trihydroxybenzene $C_6H_3(OH)_3$. 1 : 2 : 3 = 126.05. *Synonym.*—Pyrogallic Acid.

SOURCE.—It is obtained chiefly by heating Gallic Acid. $HC_7H_5O_5 = C_6H_3(OH)_3+CO_2$.

CHARACTERS.—Light, white, or nearly white laminæ, or fine needles; odorless, and having a bitter taste. It acquires a grayish tint on exposure to air and light. *Solubility.*—In 1.7 parts of water; in 1.3 parts of Alcohol, and in 1.6 parts of Ether at 25°C. (77°F.); very soluble in boiling water or boiling Alcohol.

IMPURITY.—Alkali hydroxide.

For the Therapeutics of Pyrogallol *see* p. 510.

GAMBIR

GAMBIR. *Synonym.*—Pale Catechu. A dried extract prepared from decoctions of the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiaceæ*). *Habitat.*—Eastern Asia, Malay Archipelago.

CHARACTERS.—Usually in cubical or rectangular pieces from 20 to 30 mm. in diameter; externally pale grayish-brown to reddish-brown, more or less dull and porous; internally of a light brown or dull earthy color; inodorous; taste bitterish and very astringent.

COMPOSITION.—The chief constituents are—(1) *Catechutannic Acid*, 36 to 40 per cent., the active principle, isomeric with *Catechin*, and converted into it by boiling or by the saliva, a red color being formed. (2) *Catechin* or *Catechuic Acid*, $C_{21}H_{20}O_9+5H_2O$, probably inactive. Both constituents give a green precipitate with Ferric Salts. (3) *Pyrocatechin* or *Catechol*, $C_6H_4(OH)_2$, which gives a green color with ferric chloride.

INCOMPATIBLES.—Alkalies, metallic salts, gelatin.

Dose, 1 gm. (15 gr.).

Preparation

Tinctura Gambir Composita.—Compound Tincture of Gambir. Abv. —Tr. Gambir. Co. *Synonym.*—Compound Tincture of Pale Catechu. Gambir, 50; Saigon Cinnamon, 25; by maceration and percolation with diluted Alcohol to 1000.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Gambir *see* p. 511.

KINO

KINO.—The spontaneously dried juice of *Pterocarpus Marsupium* Roxburgh (Fam. *Leguminosæ*). *Habitat.*—East Indies.

CHARACTERS.—Small, brittle, angular fragments, usually considerably less than 15 mm. in diameter, varying in color from dark reddish-brown to reddish-black; when crushed upon a slide and examined under the microscope the angular fragments are more or less translucent with a glass-like, conchoidal surface, the thinner pieces having a yellowish-red or deep brownish-red color, the pieces often being marked by nearly parallel, curved and straight lines; inodorous; taste very astringent; when masticated it colors the saliva somewhat pink. *Solubility.*—Mostly soluble in Alcohol; partly soluble in cold water.

COMPOSITION.—The chief constituents are—(1) *Kinotannic Acid*, $C_{18}H_{18}O_8$, 75 per cent. (2) *Kinoin*, a crystalline neutral principle. (3) *Pyrocatechin*, $C_6H_4(OH)_2$, a substance which reduces blue copper solutions. (4) Kino red, formed from Kinotannic acid by oxidation. (5) Gum.

INCOMPATIBLES.—Mineral acids, alkalies, all metallic salts, carbonates, gelatin.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Tinctura Kino.—Tincture of Kino. Abv.—Tr. Kino. Kino, 100. Boiling water to 1000. By boiling and decantation.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Kino *see* p. 512.

HAMAMELIS

AQUA HAMAMELIDIS. Hamamelis Water. Abv.—Aq. Hamam. *Synonyms.*—Witch Hazel Water. A saturated aqueous liquid obtained by distilling with steam or water, the bark, twigs, smaller stems or the entire shrub of *Hamamelis Virginiana* Linné (Fam. *Hamamelidaceæ*) collected in the Autumn.

SOURCE.—By distillation and addition of 150 parts of Alcohol to each 850 parts of distillate.

CHARACTERS.—Clear and colorless, or not more than faintly opalescent or slightly yellowish liquid having a characteristic odor and taste. Sp. gr., 0.979 to 0.982 at 25°C. (77°F.).

IMPURITIES.—Metallic and dissolved impurities, methyl alcohol, formaldehyde. For the Therapeutics of Hamamelis *see* p. 512.

GROUP X.—Volatile Oils and Substances Containing Them

CLASS I.—ACTING CHIEFLY ON THE CENTRAL NERVOUS SYSTEM
Valerian, Asafetida, Sumbul, Myrrh

VALERIANA

VALERIAN. Abv.—Valer. The dried rhizome and roots of *Valeriana officinalis* Linné (Fam. *Valerianaceæ*). *Habitat.*—Europe and Northern Asia; naturalized in England; cultivated.

CHARACTERS.—Rhizome upright, from 2 to 4 cm. in length and from 1 to 2 cm. in diameter, usually cut longitudinally into 2 to 4 pieces; externally yellowish-brown or dark brown, upper portion with stem-bases and frequently with a short horizontal branch or stolon, and from the outer surface arise numerous, slender, brittle roots; fracture of rhizome short and horny, internally light brown, with a thick bark and narrow central cylinder; odor pronounced, of valeric acid, becoming stronger on aging; taste sweetish, camphoraceous and somewhat bitter. *Resembling Valerian.*—Serpentaria, Arnica, Green Hellebore; but Valerian is known by its odor.

COMPOSITION.—The chief constituents are—(1) *A volatile oil,* ½ to 2 per cent., consisting of *Borneol,* $C_{10}H_{18}O$, and *Pinene,* a terpene (*see* p. 216). (2) *Valeric Acid,* $C_5H_9O_2$. It is colorless, oily, with the odor of Valerian, and strongly acid, with a burning taste. *Solubility.*—In 30 parts of water; readily in Alcohol and Ether. The amount of it in Valerian increases by keeping, while that of the oil decreases. It can be obtained from Amylic Alcohol, $C_5H_{12}O$ (Valeryl Aldehyde). (3) Formic, Acetic and Malic Acids. (4) Tannic acid. (5) Resin.

Dose, 2 gm. (30 gr.).

Preparations

1. **Tinctura Valerianæ.**—Tincture of Valerian. Abv.—Tr. Valer. Valerian, 200; by maceration and percolation with Alcohol and water to 1000.

Dose, 4 mils (1 fl. dr.).

2. Tinctura Valerianæ Ammoniata.—Ammoniated Tincture of Valerian. Abv.—Tr. Valer. Ammon. Valerian, 200; by maceration and percolation with Aromatic Spirit of Ammonia to 1000.

Dose, 2 mils (30 ♏).

AMMONII VALERAS.—Ammonium Valerate. Abv.—Ammon. Valer. A compound of Ammonia and Valeric Acid having a somewhat varying composition.

SOURCE.—By saturating Valeric Acid with Gaseous Ammonia, obtained from a mixture of Ammonium Chloride and Lime, and crystallization.

CHARACTERS.—Colorless, or white, quadrangular plates, emitting the odor of Valeric Acid; and has a sharp and sweetish taste. It is deliquescent in moist air. *Solubility.*—Soluble in 0.3 part of water and 0.6 part of Alcohol at 25°F. (77°F.); also soluble in Ether.

IMPURITIES.—Ammonium acetate, heavy metals.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

ZINC VALERAS.—Zinc Valerate. $Zn(C_5H_9O_2)_2+2H_2O=303.55$. It contains not less than 99 per cent. of the crystallized salt.

SOURCE.—From hot solutions of Zinc Sulphate and Sodium Valerate; evaporate and Zinc Valerate crystallizes out.

CHARACTERS.—White, pearly scales, or a white powder having the odor of Valeric Acid, and a sweetish, astringent and metallic taste. On exposure to the air it slowly loses Valeric Acid and becomes partially insoluble in water. *Solubility.*—In about 70 parts of water usually leaving an insoluble residue of basic salt; and in about 22 parts of Alcohol.

IMPURITIES.—Arsenic, cadmium, copper, lead, zinc chloride and sulphate, acetate and butyrate.

INCOMPATIBLES.—All acids, soluble carbonates, most metallic salts and vegetable astringents.

Dose, 0.125 gm. = 125 milligm. (2 gr.).

For the Therapeutics of Valerian *see* p. 646.

ASAFŒTIDA

ASAFETIDA. Abv.—Asafœt. *Synonym.*—Gum Asafetida. A gum-resin obtained by incising the rhizomes and roots of *Ferula Asafœtida* Linné and *Ferula fœtida* Regel, and of some other species of *Ferula* (Fam. *Umbelliferæ*). *Habitat.*—Persia, and adjacent countries. It yields not less than 60 per cent. (or if powdered, 50 per cent.) of alcohol-soluble constituents.

CHARACTERS.—In a soft mass, sometimes almost semi-liquid, or in irregular, more or less pliable masses composed of agglutinated tears of variable size imbedded in a yellowish-brown or dark-brown matrix, or in loose ovoid tears, from 1 to 4 cm. in diameter, the surface sometimes containing streaks of violet, yellowish-red or brownish-red and with a few vegetable fragments; when fresh the mass is either soft or tough, becoming hard and occasionally even brittle by drying; the surface of the freshly fractured tears is milky-white and opaque, changing gradually on exposure to a pinkish or reddish-purple or even reddish-brown;

on moistening with water, the tears become milky-white; odor persistent, alliaceous; taste bitter, alliaceous and acrid. When triturated with water, Asafetida yields a milk-white emulsion which becomes yellowish on the addition of alkalies. *Resembling Asafetida.*—Galbanum, Ammoniacum, and Benzoin, distinguished by their peculiar odors, which differ markedly from that of Asafetida.

COMPOSITION.—The chief constituents are—(1) *A volatile oil*, 5 per cent., the most important ingredient of which is Allyl sulphide, which gives Asafetida its very unpleasant odor. (2) Gum, 25 per cent. (3) Bassorin resin, 65 per cent., which contains Ferulaic Acid, $C_{10}H_{10}O_7$.

IMPURITIES.—Earthy matter, calcium sulphate and carbonate, galbanum, ammoniac, rosin, foreign resins.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparations

1. **Emulsum Asafœtidæ.**—Emulsion of Asafetida. Abv.—Emuls. Asafœt. *Synonym.*—Milk of Asafetida. Asafetida, 40; by rubbing in a warmed mortar with water, and straining to 1000.

Dose, 15 mils, (4 fl. oz.).

2. **Pilulæ Asafœtidæ.**—Pills of Asafetida. Abv.—Pil. Asafœt. Asafetida, 20; Soap, 6 gm.; Water, a sufficient quantity; to make 100 pills. Each pill contains 0.20 gm. (3 gr.) of Asafetida.

Dose, 2 pills.

3. **Tinctura Asafœtidæ.**—Tincture of Asafetida. Abv.—Tr. Asafœt. Asafetida, 200. By maceration with Alcohol, and filtration to 1000.

Dose, 1 mil (15 ♏).

For the Therapeutics of Asafetida *see* p. 647.

SUMBUL

SUMBUL. *Synonym.*—Musk Root. The dried rhizome and roots of *Ferula Sumbul* (Kauffman) Hooker filius (Fam. *Umbelliferæ*). *Habitat.*—Central and Northeastern Asia.

CHARACTERS.—In transverse segments attaining a length of 10 cm. and a diameter of 7 cm.; externally light brown to dark brown, longitudinally wrinkled and showing in the upper portions a smooth, grayish, epidermal layer, occasionally with the short stem-bases attached; fracture short, fibrous, spongy; internally light yellow or brownish-yellow, arrangement of wood, irregular, and with yellowish-brown or blackish resinous patches frequently extending over the entire ends of the segments; odor peculiar, musklike; taste bitter and somewhat aromatic.

COMPOSITION.—The chief constituents are—(1) A volatile oil. (2) Two Resins. (3) *Valeric Acid.* (4) *Sumbulic* and *Angelic Acids.*

Dose, 2 gm. (30 gr.).

Preparations

1. **Extractum Sumbul.**—Extract of Sumbul. Abv.—Ext. Sumbul. By maceration, percolation with Alcohol and water and evaporation.
Dose, 0.250 gm. = 250 milligm. (4 gr.).

2. **Fluidextractum Sumbul.**—Fluidextract of Sumbul. Abv.—Fldext. Sumbul. By percolation and maceration with Alcohol and water, and evaporation.
Dose, 2 mils (30 ♏).

For the Therapeutics of Sumbul *see* p. 648.

MYRRHA

MYRRH. *Synonym.*—Gum Myrrh. A gum-resin obtained from one or more species of *Commiphora Myrrha* (Fam. *Burseraceæ*). *Habitat.*—Eastern Africa and Southwestern Arabia.

CHARACTERS.—In rounded or irregular tears or masses, brownish-yellow or reddish-brown, and covered with a brownish-yellow dust; fracture waxy, somewhat splintery, translucent on the edges, sometimes marked with nearly white lines; odor balsamic; taste aromatic, bitter and acrid.

COMPOSITION.—The chief constituents are—(1) *Myrrhin*, $C_{48}H_{32}O_{10}$, a resin, 23 per cent. (2) *Myrrhol*, $C_{10}H_{14}O$, a volatile oil, 2 to 4 per cent. (3) Gum, 60 per cent. (4) A bitter principle.

IMPURITIES.—Many varieties of gum and gum-resins.

Myrrh is contained in Pilulæ Rhei Compositæ.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Tinctura Myrrhæ.—Tincture of Myrrh. Abv.—Tr. Myrrh. Myrrh, 200. By maceration with Alcohol and filtration to 1000.
Dose, 1 mil (15 ♏).

For the Therapeutics of Myrrh *see* p. 648.

CLASS II.—ACTING CHIEFLY ON THE BRONCHIAL MUCOUS MEMBRANE

Terebene, Terpin Hydrate, Balsam of Peru, Balsam of Tolu, Storax, Grindelia

TEREBENUM

TEREBENE. Abv.—Tereben. Probably $C_{10}H_{16} = 136.13$. A liquid consisting of dipentene and other hydrocarbons.

SOURCE.—Obtained by the action of concentrated Sulphuric Acid on Oil of Turpentine and subsequent rectification with steam.

CHARACTERS.—A colorless, thin liquid, having a rather agreeable thyme-like odor, and an aromatic, somewhat terebinthinate taste. Sp. gr., from 0.860 to 0.865. *Solubility.*—Slightly soluble in Water; soluble in 3 parts of Alcohol at 25°C. (77°F.). On exposure to light and air it gradually becomes resinified, and acquires an acid reaction.

IMPURITIES.—Unaltered oil of turpentine, rosin, resinous substances, acids.

INCOMPATIBLES.—The same as of Turpentine, *see* p. 609.

Dose, 0.25 mil (4 ♏).

For the Therapeutics of Terebene *see* p. 609.

TERPINI HYDRAS

TERPIN HYDRATE. Abv.—Terpin. Hyd. $C_{10}H_{18}(OH)_2+H_2O=190.18$. The Hydrate of the dihydric Alcohol Terpin.

SOURCE.—Rectified Oil of Turpentine, Alcohol and Nitric Acid are allowed to stand together for three or four days in shallow porcelain dishes. The crystals which have formed are collected, drained thoroughly, dried by absorbent paper, and re-crystallized in a cold solution of Alcohol.

CHARACTERS.—Colorless, lustrous, rhombic prisms, nearly odorless, and having a slightly aromatic and somewhat bitter taste. Efflorescent in dry air. *Solubility.*—Soluble in about 200 parts water; in 13 of Alcohol; in about 140 parts of Ether, 135 parts of Chloroform, at 25°C. (77°F.); also soluble in 34 parts of boiling water, in 3 parts of boiling Alcohol, and in about 1 part of boiling Glacial Acetic Acid.

Dose, 0.25 gm. = 25 milligm. (4 gr.).

For the Therapeutics of Terpin Hydrate *see* p. 609.

BALSAMUM PERUVIANUM

BALSAM OF PERU. Abv.—Bals. Peruv.. *Synonym.*—Peru Balsam. A balsam obtained from *Toluifera Pereiræ* (Royle) Balillon (Fam. *Leguminosæ*). *Habitat.*—Central America. Balsam of Peru is named from its place of export.

SOURCE.—It is prepared from the bark, after it has been beaten and scorched, by boiling in water and purification.

CHARACTERS.—A viscid liquid of a dark brown color; free from stringiness or stickiness; transparent and reddish-brown in thin layers; of an agreeable vanilla-like odor and a bitter, acrid taste, with a persistent after-taste. When swallowed, it leaves a burning sensation in the throat. It does not harden on exposure to the air. Sp. gr., 1.130 to 1.160. *Solubility.*—Soluble in Alcohol, Chloroform, or Glacial Acetic Acid with not more than a slight opalescence; only partially soluble in Ether or Petroleum Benzin. Water, when agitated with it, shows an acid reaction.

COMPOSITION.—The chief constituents are—(1) A volatile oil, in large quantities; it consists of *Benzylic Cinnamate*, $C_9H_7(C_7H_7)O_2$, about 60 per cent. (2) *Cinnamic Acid*, $C_9H_8O_2$. (3) Resin, about 32 per cent., which on dry distillation yields *Benzoic Acid*, $HC_7H_5O_2$. Small quantities of (4) Benzylic Benzoate,

$C_7H_5(C_7H_7)O_2$, (5) Benzyl Alcohol, C_7H_8O, (6) Stilbene, $C_{14}H_{12}$, (7) *Styrol*, C_8H_8, (8) *Styracin* or Cinnamyl Cinnamate, $C_9H_7(C_9H_9)O_2$, and (9) Vanillin.

IMPURITIES.—Fixed oils, fatty oils, rosin, acid resins, turpentine, storax, copaiba.

For the Therapeutics of Balsam of Peru *see* p. 336.

BALSAMUM TOLUTANUM

BALSAM OF TOLU. Abv.—Bals. Tolu. *Synonym.*—Tolu Balsam. A balsam obtained from *Toluifera Balsamum* Linné (Fam. *Leguminosæ*). *Habitat.*—Venezuela and New Granada.

SOURCE.—By incision of the bark, collection and purification.

CHARACTERS.—A yellowish-brown, or brown plastic solid, becoming brittle when old, dried, or exposed to cold. It is transparent in thin layers; has a pleasant, aromatic odor resembling that of Vanilla, and a mild, aromatic taste. *Solubility.*—Soluble in Alcohol; in Chloroform and Ether; nearly insoluble in water and Petroleum Benzin. It is dissolved by solutions of the fixed alkalies, usually leaving an insoluble residue.

COMPOSITION.—The chief constituents are—(1) *Toluene*, C_7H_8, 1 per cent.; a thin, colorless, aromatic oil. (2) *Benzylic Benzoate*, $C_7H_5(C_7H_7)O_2$, a colorless, aromatic oil. (3) *Benzylic Cinnamate*, $C_9H_7(C_7H_7)O_2$. (4) *Benzoic Acid*, $HC_7H_5O_2$. (5) *Cinnamic Acid*, $HC_9H_7O_2$. (6) Vanillin. (7) Resins.

IMPURITIES.—Rosin, copaiba, saponifiable substances.

Balsam of Tolu is contained in Tinctura Benzoini Compositæ.

Preparations

1. **Syrupus Tolutanus.**—Syrup of Tolu. Abv.—Syr. Tolu. Tincture of Tolu, 50; Magnesium Carbonate, 10; Sugar, 820; water to 1000. By solution and filtration.

   Dose, 15 mils (4 fl. dr.).

2. **Tinctura Tolutana.**—Tincture of Tolu. Abv.—Tr. Tolu. *Synonym.*—Tolu Tincture. Balsam of Tolu, 200. By maceration with Alcohol and filtration to 1000.

   Dose, 2 mils (30 ♏).

For the Therapeutics of Balsam of Tolu *see* p. 608.

STYRAX

STORAX. *Synonym.*—Liquid Storax. A balsam obtained from the wood and inner bark of *Liquidambar orientalis* Miller (Fam. *Hamamelidaceæ*). *Habitat.*—Asia Minor.

CHARACTERS.—A semi-liquid, grayish, sticky, opaque mass, depositing on standing, a heavy, dark-brown stratum; transparent in thin layers, and having a characteristic odor and an acrid taste. *Solubility.*—Insoluble in water; com-

pletely soluble (with the exception of accidental impurities) in an equal weight of warm Alcohol; almost completely soluble in Ether, Acetone, Benzene or Carbon Disulphide.

COMPOSITION.—The chief constituents are—(1) *Styrol*, C_8H_8, a volatile oil. (2) *Cinnamic Acid*, $C_9H_8O_2$, colorless, odorless, crystalline; this can be oxidized to Benzoic Acid, and is also found in Balsams of Tolu and Peru. (3) *Styracin* or *Cinnamyl Cinnamate*, $C_9H_7(C_9H_9)O_2$. (4) *Phenylpropyl Cinnamate*, $C_9H_7(C_9H_{17})O_2$. (5) *Ethyl Cinnamate*, $C_9H_7(C_2H_5)O_2$. (6) *Storesin*, $C_{36}H_{56}O_6$, in considerable quantity. (7) Vanillin, having a fragrant odor.

Dose, 1 gm. (15 gr.).

Storax is contained in Tinctura Benzoini Composita.

For the Therapeutics of Storax *see* p. 608.

GRINDELIA

GRINDELIA. Abv.—Grindel. The dried leaves and flowering tops of *Grindelia camporum* Greene, or *Grindelia cuneifolia* Nuttall, or of *Grindelia squarrosa* (Pursh) Dunal (Fam. *Compositæ*) without the presence or admixture of more than 10 per cent. of stems or other foreign matter. *Habitat.*—(1) *G. camporum* or *cuneifolia*, California, in marshes. (2) *G. squarrosa*, Western Plains to the Sierra Nevada and south to Texas.

CHARACTERS.—Stems with attached branches and terminated with resinous flower-buds; stems cylindrical, not exceeding 2 mm. in diameter; light yellow or rose-colored, with alternate leaf-scars, occasionally with basal portions of leaves, sometimes more or less irregularly flexuous and coated with resin, especially at the nodes; leaves usually separate and more or less broken and varying in shape when entire from oblong, and lanceolate to oblanceolate-spatulate and cuneate-spatulate, from 1 to 7 cm. in length, mostly sessile or amplexicaul and more or less sharply serrate or evenly spinosely toothed, pale yellow to yellowish-green, very resinous, somewhat coriaceous and brittle; bracts of flowering branches almost entire and usually more or less spreading; heads more or less resinous, viscid, many-flowered, either conical-urceolate or depressed-urceolate, involucres from 5 to 20 mm. in breadth, composed of numerous, imbricated bracts with more or less recurved tips; ray flowers yellow, ligulate and pistillate; disk-florets yellow, tubular and perfect; pappus of two or three mostly unequal linear awns about the length of the disk-florets; disk achenes more or less ovoid or oblong; more or less compressed or triquetrous, and either biauriculate or broadly unidentate or with a broad truncate, corky, thickened summit; odor balsamic; taste aromatic and bitter, resinous.

COMPOSITION.—The chief constituents are—(1) A volatile oil. (2) A resin, resembling Saponin in its action. (3) Probably an alkaloid, *Grindeline*.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Grindeliæ.—Fluidextract of Grindelia. Abv.—Fld. ext. Grindel. By maceration and percolation with Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).
For the Therapeutics of Grindelia *see* p. 610.

CLASS III.—ACTING CHIEFLY ON THE GASTRO-INTESTINAL TRACT

Pyrethrum, Clove, Eugenol, Oil of Pimenta, Pepper, Myristica, Cinnamon, Capsicum, Ginger, Cardamom Seed, Lavender, Peppermint, Menthol, Spearmint, Anise, Coriander, Fennel, Caraway, Matricaria, Red Rose.

PYRETHRUM

PYRETHRUM. Abv.—Pyreth. *Synonym.*—Pellitory Root. The dried root of *Anacyclus pyrethrum* (Linné) De Candolle (Fam. *Compositæ*). *Habitat.*—Highlands of Northern Africa.

CHARACTERS.—Nearly cylindrical, slightly tapering; usually in pieces from 2.5 to 10 cm. in length and from 5 to 20 mm. in diameter; externally dark brown, deeply longitudinally furrowed and somewhat wrinkled, occasionally bearing short, tough, hair-like rootlets, crown more or less annulate, and occasionally tufted with coarse fibers or with long, soft—woolly, nearly straight, 1-celled hairs; fracture short; bark dark brown, with 1 or 2 circular rows of resin ducts, closely adhering to the light yellow, radiate, porous wood in the medullary rays of which occur 1 to 3 rows of resin ducts; odor distinct; taste sweetish, pungent, very acrid, tingling and producing a strong sialogogue effect. *Resembling Pyrethrum.*—Taraxacum, which is darker and has not a burning taste.

COMPOSITION.—The chief constituents are—(1) Two volatile oils. (2) An acrid, brown Resin. (3) Inulin, which in many plants replaces starch, 50 per cent.

Dose, 2 gm. (30 gr.).

Preparation

Tinctura Pyrethri.—Tincture of Pyrethrum. Abv.—Tr. Pyreth.
Pyrethrum, 200; by maceration and percolation with Alcohol to 1000
For the Therapeutics of Pyrethrum *see* p. 640.

CARYOPHYLLUS

CLOVE.—Abv.—Caryoph. The dried flower buds of *Eugenia aromatica* (Linné) O. Kuntze, *Jambosa Caryophyllus* (Sprengel) Niedenzu (Fam. *Myrtaceæ*), without the presence or admixture of more than 5 per cent. of the peduncles, stems or other foreign matter. *Habitat.*—Molucca Islands; cultivated in tropical countries.

CHARACTERS.—From 10 to 17.5 mm. in length, of a dark brown or brownish-black color, consisting of a stem-like, solid inferior ovary, obscurely four-angled or somewhat compressed, terminated by four calyx teeth, and surmounted by a nearly globular head, consisting of four petals, which enclose numerous curved

stamens, and one style; odor strongly aromatic; taste pungent and aromatic, followed by slight numbness.

COMPOSITION.—The chief constituents are—(1) *Oleum Caryophylli* (*see* below), 18 per cent. (2) *Eugenin*, $C_{10}H_{12}O_2$, a crystalline body. (3) *Caryophyllin*, $C_{16}H_{16}O$, a neutral body isomeric with Camphor.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Clove is contained in Tinctura Lavandulæ Composita and Tinctura Rhei Aromatica.

OLEUM CARYOPHYLLI.—Oil of Clove. Abv.—Ol. Caryoph. A volatile oil distilled from the flower buds of *Eugenia Aromatica* (Linné) O. Kuntze, *Jambosa Caryophyllus* (Sprengel) Niedenzu (Fam. *Myrtaceæ*), and yielding not less than 82 per cent. by volume of Eugenol ($C_{10}H_{12}O_2 = 164.10$).

CHARACTERS.—A colorless or pale yellow liquid, becoming darker and thicker by age and exposure to the air, having the characteristic odor and taste of Clove. Sp. gr., 1.038 to 1.060 at 25°C. (77°F.). *Solubility.*—Soluble in 2 volumes of 70 per cent. of Alcohol.

COMPOSITION.—The chief constituents are—(1) *Eugenol* (*see* below), which is found also in Oil of Pimenta (*see* below). (2) *Caryophyllene*, a terpene, $C_{15}H_{24}$.

IMPURITY.—Phenol.

INCOMPATIBLES.—Lime water, iron salts, mineral acids, gelatin.

Dose, 0.2 mil (3 ♏).

EUGENOL

EUGENOL. $C_{10}H_{12}O_2 = 164.10$.—An unsaturated, aromatic phenol ($C_6H_3 \cdot C_3H_5 \cdot OCH_3 \cdot OH.1:3:4$) obtained from Oil of Clove and other sources.

CHARACTERS.—A colorless, or pale yellow, thin liquid, having a strongly aromatic odor of Clove and a pungent and spicy taste. Exposure to air causes it to become darker and thicker. Sp. gr., from 1.064 to 1.070. *Solubility.*—Miscible with Alcohol, Chloroform, Ether or fixed oils; it is soluble in twice its volume of 70 per cent. Alcohol.

IMPURITY.—Phenol.

Dose, 0.2 mil (3 ♏).

For the Therapeutics of Clove *see* p. 633.

OLEUM PIMENTÆ

OIL OF PIMENTA. Abv.—Ol. Piment. *Synonym.*—Oil of Allspice. A volatile oil distilled from the fruit of *Pimenta officinalis* Lindley (Fam. *Myrtaceæ*), yielding not less than 65 per cent., by volume, of Eugenol ($C_{10}H_{12}O_2 = 164.10$).

CHARACTERS.—A colorless, yellow, or reddish liquid, becoming darker with age, and having the characteristic odor and taste of Allspice. Sp. gr., 1.018 to 1.048 at 25°C. (77°F.). *Solubility.*—Soluble in an equal volume of 90 per cent. Alcohol; also soluble in 2 volumes of 70 per cent. Alcohol.

COMPOSITION.—(1) *Eugenol* (*see* above). (2) A sesquiterpene.

Dose, 0.2 mil (3 ♏).

For the Therapeutics of Oil of Pimenta *see* p. 634.

PIPER

PEPPER. *Synonym.*—Black Pepper. The dried, unripe fruit of *Piper nigrum* Linné (Fam. *Piperaceæ*), without the presence or admixture of more than 2 per cent. of stems or other foreign matter. *Habitat.*—India; cultivated in the tropics.

CHARACTERS.—Nearly globular, 3.5 to 6 mm. in diameter, epicarp very thin, easily separable from the sarcocarp; externally blackish-brown or grayish-black, coarsely reticulate; unilocular, 1-seeded; seed nearly white, hollow, adhering to the pericarp; odor aromatic, slightly empyreumatic; taste aromatic and very pungent. *Resembling Black Pepper.*—Pimenta, which has a calyx; Cubeb, which is stalked.

COMPOSITION.—The chief constituents are—(1) An *Oleoresin*, readily yielding a volatile oil (1 to 2 per cent.), with the odor of pepper, and a resin. (2) *Piperine* 6 to 8 per cent. (3) Starch,

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparation

Oleoresina Piperis.—Oleoresin of Pepper. Abv.—Oleores. Piper. By percolation with Ether, distillation and evaporation of the residue, and straining.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

For the Therapeutics of Pepper *see* p. 640.

MYRISTICA

MYRISTICA. Abv.—Myrist. *Synonym.*—Nutmeg. The ripe seeds of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*), deprived of the arilli and seed-coats. *Habitat.*—Molucca Islands; cultivated in tropical countries.

CHARACTERS.—Ovoid or ellipsoidal, from 20 to 30 mm. in length and about 20 mm. in thickness; externally light brown to dark brown, reticulately furrowed, the broad end with a large, circular, upraised scar from which arises a furrow extending to the chalaza; easily cut, the surface having a waxy lustre and mottled by reason of the light brown perisperm penetrating into the yellowish-brown endosperm; a longitudinal section through the endosperm above the large scar shows a small irregular cavity with the more or less shrunken remains of the embryo, and usually containing a growth of mold; odor and taste agreeably aromatic.

COMPOSITION.—The chief constituents are—(1) A *fixed oil*, 25 to 30 per cent. (2) The *volatile oil* (*see* below), 2 to 8 per cent.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Myristica is contained in Pulvis Aromaticus, Tinctura Lavandulæ Composita, and Tinctura Rhei Aromatica.

OLEUM MYRISTICÆ.—Oil of Myristica. Abv.—Ol. Myrist. *Synonym.*—Oil of Nutmeg. A volatile oil distilled from the kernel of the ripe seed of *Myristica fragrans* Houttuyn (Fam. *Myristicaceæ*).

CHARACTERS.—A colorless or pale yellow liquid, having the characteristic odor and taste of Nutmeg. Sp. gr., 0.859 to 0.924 at 25°C. (77 F.). *Solubility.*—In an equal volume of Alcohol; also in 3 volumes of 90 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Myristicene*, $C_{10}H_{16}$, a terpene. (2) *Myristicol*, $C_{10}H_{14}O$, a stearopten, isomeric with *Carvone* (*see* p. 210).

Dose, 0.2 mil (3 ♏).

Oil of Myristica is contained in Spiritus Ammoniæ Aromaticus.

For the Therapeutics of Myristica *see* p. 634.

CINNAMOMUM

CINNAMOMUM SAIGONICUM.—Saigon Cinnamon. Abv.—Cinnam. Saigon. The dried bark of an undetermined species of *Cinnamomum* (Fam. *Lauraceæ*). *Habitat.*—China.

CHARACTERS.—In quills attaining a length of 30 cm., and from 3 to 30 mm. in diameter; the bark from 0.5 to 3 mm. in thickness; outer surface light brown to dark purplish-brown with grayish patches of foliaceous lichens and numerous bud-scars; finely wrinkled, especially the bark of younger twigs, otherwise more or less rough from corky patches surrounding the lenticels; inner surface reddish-brown to dark brown, granular, and slightly striate; fracture short; inner bark porous, owing to the presence of large oil cells and mucilage cells, and separated by a continuous layer of stone cells from the outer bark; odor aromatic; taste sweetish, aromatic and pungent.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Saigon Cinnamon is contained in Tinctura Cardamomi Composita, Tinctura Gambir Composita, Tinctura Lavandulæ Composita and Tinctura Rhei Aromatica.

Preparations

1. **Fluidextractum Aromaticum.**—Aromatic Fluidextract. Abv.—Fldext. Aromat. Aromatic Powder, by maceration and percolation with Alcohol.

Dose, 1 mil (15 ♏).

2. **Pulvis Aromaticus.**—Aromatic Powder. Abv.—Pulv. Aromat. Saigon Cinnamon, 35; Jamaica Ginger, 35; Cardamom Seed, 15; Myristica 15.

Dose, 1 gm. (15 gr.).

3. **Tinctura Cinnamomi.**—Tincture of Cinnamon. Abv.—Tr. Cinnam. Saigon Cinnamon, 200; Glycerin, 75; Alcohol and water to 1000. By maceration and percolation.

Dose, 2 mils (30 ♏).

CINNAMOMUM ZEYLANICUM.—Ceylon Cinnamon. Abv.—Cinnam. Zeylan. The dried bark of cultivated trees of *Cinnamomum zeylanicum* Breyne (Fam. *Lauraceæ*), without the presence or admixture of more than 3 per cent. of the outer bark or other foreign matter. *Habitat.*—Ceylon; cultivated.

CHARACTERS.—In closely rolled double quills, composed of 7 to 12 thin layers of separate pieces of bark, from 30 to 50 mm. in length and from 8 to 13 mm. in diameter; the bark attaining a thickness of 1 mm.; outer surface pale yellowish-brown, smooth, longitudinally striate with narrow yellowish groups of bast-fibers, and showing circular or irregular brownish patches, occasionally with perforations marking the nodes; inner surface light brown, with faint longitudinal striations; fracture short with projecting bast-fibers; odor agreeably aromatic taste sweetish and warmly aromatic.

COMPOSITION.—The chief constituents are—(1) A Volatile Oil, ½ to 1½ per cent. (2) Tannic Acid. (3) Sugar. (4) Mannite.

IMPURITY.—Cassia Bark.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

OLEUM CASSIÆ.—Oil of Cinnamon. Abv.—Ol. Cass. *Synonym.*—Oil of Cassia. A volatile oil distilled from *Cinnamomum Cassia* (Nees) Blume (Fam. *Lauraceæ*), rectified by steam distillation and yielding not less than 80 per cent., by volume, of Cinnamic Aldehyde ($C_9H_8O = 132.06$).

CHARACTERS.—A yellowish or brownish liquid, becoming darker and thicker by age and exposure to the air and having the characteristic odor and taste of Cinnamon. Sp. gr., 1.045 to 1.063 at 25° C. (77° F.) *Solubility.*—In 2 volumes of 70 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Cinnamic Aldehyde.* (2) *Eugenol*, found also in the Oils of Clove and Myristica. (3) In old oil, *Cinnamic Acid*, $HC_9H_7O_2 = 145.95$. A colorless, crystalline, volatilizable substance, slightly soluble in water, readily soluble in Alcohol, and convertible by Nitric Acid, with heat, into Benzoic Acid.

IMPURITIES.—Copper, lead, petroleum, rosin.

Dose, 0.2 (3 ♏).

Oil of Cinnamon is contained in Acidum Sulphuricum Aromaticum.

Preparations

1. **Aqua Cinnamomi.**—Cinnamon Water. Abv.—Aq. Cinnam. Oil of Cinnamon, 2; by trituration with Purified Talc, 15, and addition of Distilled Water to 1000.

Dose, 15 mils (4 fl. dr.).

Cinnamon Water is contained in Infusum Digitalis and Mistura Cretæ.

2. **Spiritus Cinnamomi.**—Spirit of Cinnamon. Oil of Cinnamon, 100; Alcohol, to 1000.

Dose, 2 mils (30 ♏).

Spirit of Cinnamon is contained in Syrupus Rhei.

For the Therapeutics of Cinnamon *see* p. 635.

CAPSICUM. Abv.—Capsic. *Synonyms.*—Cayenne Pepper. African Chillies. The dried, ripe fruits of *Capsicum frutescens* Linné (Fam. *Solanaceæ*), without the presence or admixture of more than 2 per cent. of stems, calyxes or other foreign matter. *Habitat.*—Tropical America; cultivated in tropical countries.

CHARACTERS.—Oblong-conical, from 8 to 20 mm. in length and from 2 to 15 mm. in diameter; pericarp brownish-red or orange, shining, membranous and transulcent; pericarp; 2 or 3 loculate, united below and containing 6 to 17 flat, reniform, yellowish seeds attached to the placenta or frequently separated from it; odor characteristic, sternutatory; taste intensely pungent.

COMPOSITION.—The chief constituents are—(1) *Capsaicin*, $C_9H_{14}NO_2$, a crystallizable acrid substance. (2) *Capsicin*, a volatile alkaloid, smelling like Coniine. (3) A fixed oil. (4) A resin. (5) Fatty matter.

IMPURITIES.—Various red substances, *e.g.*, red-lead.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparations

1. **Emplastrum Capsici.**—Capsicum Plaster. Abv.—Emp. Capsic. Oleoresin of Capsicum and Rubber Plaster spread on fabric.

2. **Oleoresina Capsici.**—Oleoresin of Capsicum. Abv.—Oleores. Capsic. By percolation with Ether, distillation, and evaporation of the residue.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

3. **Tinctura Capsici.**—Tincture of Capsicum. Abv.—Tr. Capsic. Capsicum, 100. By percolation with Alcohol and Water to 1000.

Dose, 0.5 mil (8 ♏).

For the Therapeutics of Capsicum *see* p. 641.

ZINGIBER

GINGER. Abv.—Zingib. The dried rhizomes of *Zingiber officinale* Roscoe (Fam. *Zingiberaceæ*), the outer cortical layers of which are either partially or completely removed. *Habitat.*—India; cultivated in the tropics.

CHARACTERS. **Jamaica Ginger.**—Rhizomes free from the outer corky layers, in horizontal, laterally compressed, irregular branched pieces, from 4 to 16 cm. in length; and from 4 to 20 mm. in thickness; externally light brown, longitudinally striate, ends of the branches with depressed stem-scars; fracture short-fibrous, mealy and resinous; internally yellowish to light brown, cortex thin, endodermis a thin yellow layer enclosing a large central cylinder with numerous groups of fibro-vascular bundles and yellowish oil cells; odor agreeably aromatic; taste aromatic and pungent.

African Ginger.—Rhizomes with cork partly removed on the flattened sides, the patches without cork, smooth and of a light color, the portions with cork longitudinally or reticulately wrinkled and grayish-brown; fracture short or short-fibrous, internally lemon-yellow or dark bluish with yellowish oil-secretion cells and light yellow to reddish-brown resin cells; odor strongly aromatic; taste intensely pungent.

Calcutta Ginger.—Rhizomes resembling the African Ginger, the branches or "fingers" being somewhat larger, and with a considerable proportion of shriveled

pieces, externally grayish-brown or grayish-blue; fracture short and mealy, or horny; internally light yellow or light brownish-yellow with numerous yellowish oil cells and yellowish-brown resin cells; odor aromatic; taste starchy and strongly pungent.

Calicut Ginger.—Rhizomes resembling African Ginger, more of the periderm being usually removed; externally more or less uniformly light brown; fracture short or short-fibrous, and mealy; internally light-yellow or brownish-yellow with numerous yellowish oil and resin-cells; odor aromatic; taste very pungent.

Cochin Ginger.—Rhizomes with more of the corky layer removed on the flattened sides; externally light brown to grayish-yellow, fracture short and mealy; internally, yellowish-white with numerous yellowish oil cells and brownish-red or blackish resin cells; odor aromatic; taste pungent but not so persistent as in the African variety.

Japanese Ginger.—Rhizome somewhat resembling Cochin Ginger but usually with a thin coating of lime; externally nearly smooth or slightly wrinkled and of a whitish color; fracture short and very mealy; internally varying from a yellowish-white to light brown and with numerous brownish-red resin cells; odor aromatic; taste pungent.

Resembling Ginger.—Turmeric, which is yellow.

COMPOSITION.—The chief constituents are—(1) An aromatic volatile oil (¾ to 2 per cent.), giving the flavor. (2) Resin. (3) *Gingerol*, to which the pungent taste is due (Thresh).

Dose, 1 gm. (15 gr.).

Ginger is contained in Fluidextractum Aromaticum, Pulvis Aromaticus and Pulvis Rhei Compositus.

Preparations

1. **Fluidextractum Zingiberis.**—Fluidextract of Ginger. Abv.—Fldext. Zingib. By maceration and percolation with Alcohol, and evaporation.

Dose, 1 mil (15 ♏).

2. **Oleoresina Zingiberis.**—Oleoresin of Ginger. Abv.—Oleores. Zingib. By percolation with Ether, distillation, and evaporation of the residue.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

3. **Syrupus Zingiberis.**—Syrup of Ginger. Abv.—Syr. Zingib. Fluidextract of Ginger, 30; Alcohol, 20; Sugar, 820; water to 1000. By trituration with Magnesium Carbonate, 10, solution and filtration.

Dose, 15 mils. (4 fl. dr.).

4. **Tinctura Zingiberis.**—Tincture of Ginger. Abv.—Tr. Zingib. Ginger, 200. By percolation with Alcohol to 1000.

Dose, 2 mils. (30 ♏).

Tincture of Ginger is contained in Acidum Sulphuricum Aromaticum. For the Therapeutics of Ginger *see* p. 642.

CARDAMOMI SEMEN

CARDAMOM SEED.—Abv.—Cardam. Sem. The dried seeds of *Elettaria Cardomomum* White et Maton (Fam. *Zingiberaceæ*), recently removed from the capsules. *Habitat.*—Malabar; cultivated in India.

CHARACTERS.—Mostly agglutinated in groups of from 2 to 7, the individual seeds, oblong-ovoid in outline, 3- or irregularly 4-sided, convex on the dorsal surface, strongly longitudinally grooved on one side, from 3 to 4 mm. in length; externally reddish-gray-brown, coarsely tuberculated, and with more or less adhering portions of the membranous aril; in section showing a thin reddish-brown seed-coat, a large white perisperm and a central, greenish endosperm, enclosing a small straight embryo; odor aromatic; taste aromatic, pungent. The seeds alone contain active and valuable constituents.

COMPOSITION.—The chief constituents are—(1) A volatile oil, 4 to 5 per cent., which contains a terpene $C_{10}H_{16}$, called *Terpinene*. (2) A fixed oil 10 to 11 per cent.

Dose, 1 gm. (15 gr.).

Cardamom is contained in Extractum Colocynthidis Compositum, Fluidextractum Aromaticum, Pulvis Aromaticus, Tinctura Gentianæ Composita, and Tinctura Rhei.

Preparations

1. **Tinctura Cardamomi.**—Tincture of Cardamom. Abv.—Tr. Cardam. Cardamom, 200. By maceration and percolation with Diluted Alcohol to 1000.

Dose, 2 mils (30 ♏).

2. **Tinctura Cardamomi Composita.**—Conpound Tincture of Cardamom. Abv.—Tr. Cardam. Co. Cardamom, 20, Saigon Cinnamon, 25; Caraway, 12; Cochineal, 5; By percolation with Glycerin, 50, and Diluted Alcohol to 1000.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Cardamom Seed *see* p. 642.

LAVANDULA

OLEUM LAVANDULÆ.—Oil of Lavender. Abv.—Ol. Lavand. A volatile oil distilled from the fresh flowering tops of *Lavandula vera* DeCandolle (*Lavandula officinalis* Chaix, *Lavandula spica* Linné) (Fam. *Labiatæ*). *Habitat.*—Southern Europe, cultivated.

CHARACTERS.—A colorless or yellow liquid, having the characteristic odor and taste of Lavender Flowers. Sp. gr., 0.875 to 0.888 at 25°C (77°F.). *Solubility.*—In 3 volumes of 70 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Linalool Acetate.* (2) *Linalool*, $C_{10}H_{18}O$, which is an alcohol and an oxidation product of the terpene, *Myrcene* $C_{10}H_{16}$. It is isomeric with *Borneol* (*see* p. 190), *Geraniol* (*see* p. 184) and

Menthol (*see* p. 206). (3) *Cineol* or *Eucalyptol*, also found in Oil of Eucalyptus (*see* p. 221) and other volatile oils.

IMPURITY.—Alcohol.

Oil of Lavender Flowers is contained in Linimentum Saponis Mollis, Spiritus Ammoniæ Aromaticus, and Unguentum Diachylon.

Dose, 0.2 mil (3 ♏).

Preparations

1. **Spiritus Lavandulæ.**—Spirit of Lavender. Abv.—Sp. Lavand. Oil of Lavender, 50; Alcohol, to 1000.

Dose, 2 mils (30 ♏).

2. **Tinctura Lavandulæ Composita.**—Compound Tincture of Lavender. Abv.—Tr. Lavand. Co. Oil of Lavender, 8; Oil of Rosemary, 2; Saigon Cinnamon, 20; Clove, 5; Myristica, 10; Red Saunders, 10; Alcohol and water, each a sufficient quantity to make 1000. By maceration and filtration.

Dose, 2 mils (30 ♏).

Compound Tincture of Lavender is contained in Liquor Potassii Arsenitis.

For the Therapeutics of Lavender *see* p. 635.

MENTHA PIPERITA

PEPPERMINT.—Abv.—Menth. Pip. The dried leaves and flowering tops of *Mentha piperita* Linné (Fam. *Labiatæ*). *Habitat.*—Wild in Asia, Europe, and North America; cultivated.

CHARACTERS.—Leaves more or less crumpled and frequently detached from the stems; stems quadrangular, from 1 to 2 mm. in diameter, glabrous except for a few scattered, deflexed hairs; leaves when entire petiolate, ovate-oblong to oblong-lanceolate, petioles from 4 to 15 mm. in length, slightly pubescent, laminæ from 1 to 9 cm. in length, acute and sharply serrate, light green to purplish-brown, upper surfaces nearly glabrous, lower surfaces glandular hairy, especially on the veins; flower-whorls in oblong or oval spikes which are usually compact, or somewhat interrupted at the base, from 1 to 1.5 cm. in breadth, rounded at the summit, and in fruit attaining a length of from 3 to 7 cm.; bracts oblong-lanceolate, very acuminate, 7 mm. in length; calyx tubular, equally 5-toothed; pubescent and glandular-punctate, often dark purple in color; corolla tubular-campanulate, 4-cleft, about 3 mm. in length and often light purple; stamens 4, short and equal; rootlets ellipsoidal, about 0.5 mm. in diameter, blackish-brown; odor aromatic, characteristic taste aromatic, pungent, followed by a cooling sensation in the mouth.

COMPOSITION.—Its chief constituents are—(1) A volatile oil (*see* below); (2) A liquid, and (3) a crystalline *Menthol* (*see* p. 206).

Dose, 4 gm. (60 gr.).

OLEUM MENTHÆ PIPERITÆ.—Oil of Peppermint. Abv.—Ol Menth. Pip. A volatile oil distilled from the flowering *Mentha piperita* Linné (Fam.

Labiatæ), rectified by steam distillation, and yielding, not less than 5 per cent. of Esters, calculated as Menthyl Acetate ($C_{10}H_{19}C_2H_3O_2 = 198.18$), and not less than 50 per cent. in total Menthol ($C_{10}H_{19}OH = 156.16$) free and as Esters.

CHARACTERS.—A colorless liquid, having a strong odor of Peppermint, and a pungent taste, followed by a sensation of cold when air is drawn into the mouth. Sp. gr., 0.896 to 0.908 at 25°C (77°F.). *Solubility.*—In 4 volumes of 70 per cent. alcohol, showing not more than a slight opalescence.

COMPOSITION.—The chief constituents are—(1) *Menthene*, $C_{10}H_{18}$, the liquid terpene obtained by distillation. (2) *Menthol* (see below), 50 to 65 per cent.

Dose, 0.2 mil (3 ♏).

Oil of Peppermint is contained in Pilulæ Rhei Compositæ.

Preparations

1. **Aqua Menthæ Piperitæ.**—Peppermint water. Abv.—Aq. Menth. Pip. Oil of Peppermint, 2. By trituration with Purified Talc, 15, and filtration with Distilled water to 1000.

Dose, 15 mils (4 fl. dr.).

2. **Spiritus Menthæ Piperitæ.**—Spirit of Peppermint. Abv.—Sp. Menth. Pip. Oil of Peppermint, 100; Peppermint, 10. By maceration and percolation with Alcohol and filtration to 1000.

Dose, 2 mils (30 ♏).

MENTHOL

MENTHOL. $C_{10}H_{19}OH = 156.16$.—A secondary Alcohol obtained from the oil from *Mentha piperita* Linné, or from other mint oils.

SOURCE.—By fractional distillation of the volatile oil and freezing the higher boiling product, and crystallization.

CHARACTERS.—Colorless, acicular or prismatic crystals, having a strong odor and taste of Peppermint, when tasted it produces a sensation of warmth followed by cold when air is drawn into the mouth. *Solubility.*—Slightly soluble in water, but imparts to the latter its odor and taste; very soluble in Alcohol, Ether and Chloroform.

IMPURITIES.—Thymol, wax, paraffin, inorganic substances.

Dose, 0.060 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Peppermint *see* p. 636.

MENTHA VIRIDIS

SPEARMINT.—Abv.—Menth. Vir. The dried leaves and flowering tops of *Mentha spicata* Linné (*Mentha viridis* Linné) (Fam. *Labiatæ*). *Habitat.*—Wild in Europe and North America; cultivated.

CHARACTERS.—Leaves more or less crumpled and mixed with a large proportion of the light brown or purplish-colored stems, occasionally with their characteristic opposite branches; stems distinctly quadrangular, from 1 to 3 mm. in width, nearly glabrous; leaves, when entire ovate-lanceolate, unequally serrate,

nearly sessile or with a petiole less than 5 mm. in length, of a bright green color and somewhat glandular hairy on the under surface; flowers arranged in opposite clusters and in more or less interrupted or crowded lanceolate, nearly acute spikes; bracts linear-lanceolate, subulate, from 7 to 10 mm. in length, subtending the flower-clusters; calyx-tubular, 5-toothed, glandular punctate and somewhat pubescent near the teeth; corolla nearly white or light brown; stamens extending beyond the corolla tube; odor slightly pungent, characteristic; taste aromatic, characteristic but not followed by a cooling sensation in the mouth.

COMPOSITION.—(1) A volatile oil (*see* below). (2) Resin. (3) Gum.

Dose, 4 gm. (60 gr.).

OLEUM MENTHÆ VIRIDIS.—Oil of Spearmint. Abv.—Ol. Menth. Vir. A volatile oil distilled from the flowering tops of *Mentha spicata* Linné (*Mentha viridis* Linné) (Fam. *Labiatæ*), and yielding not less than 43 per cent. by volume of Carvone ($C_{10}H_{14}O = 150.11$), rectified by steam distillation.

CHARACTERS.—A colorless, yellow, or greenish-yellow liquid, having the characteristic odor and taste of Spearmint. Sp. gr., 0.917 to 0.934 at 25°C, (77°F.). *Solubility.*—In 1 volume of 80 per cent. Alcohol forming a clear solution; on further dilution, it usually becomes cloudy.

COMPOSITION.—The chief constituents are—(1) *Menthene*, the same terpene as in Peppermint. (2) *Carvone*, $C_{10}H_{14}O$, isomeric with Thymol (*see* p. 214).

Dose, 0.2 mil (3 ♏).

Preparations

1. Aqua Menthæ Viridis.—Spearmint water. Abv.—Aq. Menth. Vir. Oil of Spearmint, 2. By trituration with Purified Talc, 15, addition of Distilled Water and filtration to 1000.

Dose, 15 mils (4 fl. dr.).

2. Spiritus Menthæ Viridis.—Spirit of Spearmint. Abv.—Sp. Menth. Vir. Oil of Spearmint, 100; Spearmint, 10. By maceration with Alcohol and filtration to 1000.

Dose, 2 mils (30 ♏).

For the Therapeutics of Spearmint *see* p. 637.

ANISUM

ANISE. Abv.—Anis. The dried ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*), without the presence or admixture of more than 3 per cent. of foreign seeds or other vegetable matter. *Habitat.*—Western Asia, Egypt, Southeastern Europe; cultivated.

CHARACTERS.—Cremocarp broadly ovoid or pyriform, laterally compressed, from 3 to 6 mm. in length and from 2 to 3 mm. in breadth; mericarps usually cohering and attached to a slender pedicel; from 2 to 12 mm. in length; summit with a ring-like disk and 2 projecting, diverging styles; externally grayish or greenish-gray, seldom grayish-brown, slightly pubescent; each with five light brown filiform ridges and in cross-section with from 15 to 45 vittæ; odor and taste agreeable and aromatic. *Resembling Anise.*—Conium, which has single meri-

carps, smooth, grooved upon the face, and having crenate ridges with wrinkles between them, and no oil-tubes.

COMPOSITION.—The chief constituent is the *volatile oil* (*see* below).

IMPURITY.—Conium.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

OLEUM ANISI.—Oil of Anise. Oil of Star Anise. Abv.—Ol. Anisi. A volatile oil distilled from the ripe fruit of *Pimpinella Anisum* Linné (Fam. *Umbelliferæ*) or from the ripe fruit of *Illicium verum* Hooker filius (Fam. *Magnoliaceæ*). The botanical source from which it is derived must be stated on the label.

CHARACTERS.—A colorless or pale yellow, strongly refractive liquid, having the characteristic odor and taste of Anise. Sp. gr., 0.978 to 0.988 at 25° (77°F.). *Solubility.*—In 3 volumes of 90 per cent. Alcohol, with not more than a slight cloudiness.

COMPOSITION.—The chief constituents are—(2) A Terpene, $C_{10}H_{16}$, in small quantity. (2) *Anethol*, $C_{10}H_{12}O$, a stearopten, 80 per cent.

IMPURITIES.—Alcohol, petroleum, oil of turpentine, oil of fennel, fixed oils, volatile oils containing phenols.

Dose, 0.2 mil (3 ♏).

Oil of Anise is contained in Spiritus Aurantii Compositus, Syrupus Sarsaparillæ Compositus and Tinctura Opii Camphorata.

Preparations

1. **Aqua Anisi.**—Anise water. Abv.—Aq. Anisi. Oil of Anise, 2. By trituration with Purified Talc, 15, addition of Distilled water, and filtration to 1000.

Dose, 15 mils (4 fl. dr.).

2. **Spiritus Anisi.**—Spirit of Anise. Abv.—Sp. Anisi. Oil of Anise, 100; Alcohol, to 1,000.

Dose, 2 mils (30 ♏).

For the Therapeutics of Anise *see* p. 637.

CORIANDRUM

CORIANDER. Abv.—Coriand. The dried ripe fruit of *Coriandrum sativum* Linné, (Fam. *Umbelliferæ*), without the presence or admixture of more than 5 per cent. of other fruits, seeds or foreign matter. *Habitat.*—Central Asia and Southern Europe; cultivated.

CHARACTERS.—Mericarps usually coherent; cremocarp nearly globular, from 3 to 5 mm. in diameter; externally light brown or rose colored; summit with calyx-teeth and a short stylopodium; each mericarp with five prominent, straight longitudinal primary ribs and 4 indistinct, undulate secondary ribs; mericarps easily separated, deeply concave on the inner or commissural surface and showing in transverse section 2 vittæ on the inner surface of each; odor and taste agreeably aromatic.

COMPOSITION.—The chief constituent is the *volatile oil* (*see* below).
Dose, 0.500 gm. = 500 milligm. (8 gr.).

OLEUM CORIANDRI.—Oil of Coriander. Abv.—Ol. Coriand. A volatile oil distilled from the ripe fruit of *Coriandrum sativum* Linné (Fam. *Umbelliferæ*).

CHARACTERS.—A colorless or pale yellow liquid, having the characteristic, odor and taste of Coriander. Sp. gr., 0.863 to 0.875 at 25°C. (77°F.). *Solubility.*—In 3 volumes of 70 per cent. Alcohol.

COMPOSITION.—(1) *Pinene*, the chief terpene of Oil of Turpentine, 5 per cent. (2) *Coriandrol*, $C_{10}H_{18}O$, which is isomeric with *Borneol* (*see* p. 190).

Dose, 0.2 mil (3 ♏).

Oil of Coriander is contained in Spiritus Aurantii Compositus and Syrupus Sennæ.

For the Therapeutics of Coriander *see* p. 638.

FŒNICULUM

FENNEL. Abv.—Fœnic. The dried, ripe fruit of cultivated varieties of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*), without the presence or admixture of more than 4 per cent. of foreign matter. *Habitat.*—Levant and Southern Europe; cultivated.

CHARACTERS.—Mericarps usually separate, each being broadly elliptical, more or less curved, from 4 to 10 mm. in length and from 2 to 3.5 mm. in breadth, some having a slender stalk from 2 to 10 mm. in length; dorsal surface convex, yellowish-green to grayish-brown, with 3 prominent, longitudinal primary ribs and at the summit a short, conical stylopodium; commissural surface with 3 narrow, light brown, longitudinal areas separated by two dark brown or brownish-black areas containing the vittæ or oil-tubes; odor and taste aromatic and characteristic. *Resembling Fennel.*—Conium fruit. Fennel is larger and has prominent oil-tubes. Caraway and Anise fruits.

COMPOSITION.—The chief constituent is the *volatile oil* (*see* below), probably chemically identical with Oil of Anise (*see* p. 208).

Fennel is contained in Infusum Sennæ Compositum.

Dose, 1 gm. (15 gr.).

OLEUM FŒNICULI.—Oil of Fennel. Abv.—Ol. Fœnic. A volatile oil distilled from the ripe fruit collected from cultivated varieties of *Fœniculum vulgare* Miller (Fam. *Umbelliferæ*). If partly or wholly solidified, it should be completely liquefied by warming, and then well shaken, before being dispensed.

CHARACTERS.—A colorless or pale yellow liquid, having the characteristic, odor and taste of Fennel. Sp. gr., 0.953 to 0.973 at 25°C. (77°F.) *Solubility.*—In 8 volumes of 80 per cent. Alcohol and in 1 volume of 90 per cent. Alcohol.

IMPURITIES.—Volatile oils containing phenols.

Dose, 0.2 mil (3 ♏).

Oil of Fennel is contained in Pulvis Glycyrrhizæ Compositus and Spiritus Juniperi Compositus.

Preparation

Aqua Fœniculi.—Fennel water. Abv.—Aq. Fœnic. Oil of Fennel, 2. By trituration with Purified Talc, 15, addition of Distilled Water, and filtration to 1000.

Dose, 15 mils (4 fl. dr.).

For the Therapeutics of Fennel *see* p. 638.

CARUM

CARAWAY. *Synonym.*—Caraway Seed. The dried fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*), without the presence or admixture of more than 3 per cent. of other fruits, seeds or foreign matter. *Habitat.*—Central and Western Asia; cultivated.

CHARACTERS.—Mericarps usually separated, crescent-shaped, 3 to 7 mm. in length, 1.5 mm. in diameter; externally dark brown with 5 yellowish filiform ribs; in transverse section nearly equilaterally pentagonal, the commissural surface with two vittæ; the dorsal surface with a vitta between each of the primary ribs; oily endosperm large, enclosing a small embryo; odor and taste agreeably aromatic. *Resembling Caraway.*—Conium and Fennel. Caraway is known by its small ridges and spicy taste.

COMPOSITION.—The chief constituent is the volatile oil (*see* below), 5 to 7 per cent.

Dose, 1 gm. (15 gr.).

Caraway is contained in Tinctura Cardamomi Composita.

OLEUM CARI.—Oil of Caraway. Abv.—Ol. Cari. A volatile oil distilled from the fruit of *Carum Carvi* Linné (Fam. *Umbelliferæ*) and yielding not less then 50 per cent. by volume of Carvone ($C_{10}H_{14}O = 150.11$).

CHARACTERS.—A colorless, or pale yellow, thin liquid, having the characteristic, odor and taste of Caraway. Sp. gr., 0.900 to 0.910 at 25°C. (77°F.). *Solubility.*—In 8 volumes of 80 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Cymene*, $C_{10}H_{14}$; also found in Oil of Eucalyptus (*see* p. 221). (2) *Carvone* $C_{10}H_{14}O$, isomeric with Thymol (*see* p. 214), also found in Oil of Spearmint. (3) *Limonene*, a terpene, $C_{10}H_{16}$; also found in Oil of Lemon (*see* p. 186).

Dose, 0.2 mil (3 ♏).

Oil of Caraway is contained in Spiritus Juniperi Compositus.

For the Therapeutics of Caraway *see* p. 638.

MATRICARIA

MATRICARIA. Abv.—Matricar. *Synonyms.*—German Chamomile. Wild Chamomile. The dried flower-heads of *Matricaria Chamomilla* Linné (Fam. *Compositæ*), without the presence or admixture of more than 5 per cent. of stems or foreign matter. *Habitat.*—Europe and Western Asia.

CHARACTERS.—Flower-heads composed of a few white ray-florets and numerous yellow disk-florets on conical, more or less hollow receptacles, the latter being from 3 to 10 mm. in breadth; disk-flowers, tubular, perfect and without a pappus; ray-flowers from 10 to 20, pistillate, corolla white, 3-toothed and 4-veined, usually reflexed; involucre hemispherical, composed of from 20 to 30 imbricated, oblanceolate, and pubescent scales; peduncles light green to brownish-green, longitudinally furrowed, more or less twisted, and attaining a length of 2.5 cm., achenes somewhat ovoid and faintly 3- to 5-ribbed; pappus none, or only a slight membraneous crown; odor pleasant, aromatic; taste aromatic and bitter. *Resembling Matricaria.*—*Anethemis arvensis* and *Anthemis Cotula*, but these have conical, solid, and chaffy receptacles.

COMPOSITION.—(1) *Volatile oil*, ¼ per cent. (2) Anthemic acid. (3) *Anthemidin*, probably a glucoside. (4) Tannicsacid.

Dose, 15 gm. (240 gr.).

For the Therapeutics of Matricaria *see* p. 638.

ROSA GALLICA

RED ROSE. Abv.—Rosa Gall. The dried petals of *Rosa gallica* Linné (Fam. *Rosaceæ*), collected just before the expansion of the flower. *Habitat.*—Asia Minor and Southern Europe; cultivated.

CHARACTERS.—Petals either separate or imbricated in small cones, broadly ovate, summit rounded and deeply notched, margin entire and somewhat recurved; base obtuse; externally of a purplish-red color except the light-brown claw; texture velvety; when dry brittle; odor agreeable; taste astringent and slightly bitter.

COMPOSITION.—The chief constituents are—(1) *Volatile oil*, in minute quantities. (2) Tannic acid. (3) Mucilage. (4) Sugar.

Preparations

1. **Fluidextractum Rosæ.**—Fluidextract of Rose. Abv.—Fldext. Rosæ. By maceration with Glycerin and Diluted Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

2. **Mel Rosæ.**—Honey of Rose. Fluidextract of Rose, 120; Clarified Honey, to 1000.

Dose, 4 mils (1 fl. dr.).

AQUA ROSÆ FORTIOR.—Stronger Rose Water. Abv.—Aq. Ros. Fort. The saturated aqueous distillate prepared by distilling the fresh flowers of *Rosa centifolia* Linné (Fam. *Rosaceæ*) with water.

CHARACTERS.—A colorless and clear liquid, possessing a strong and pleasant odor and a taste of fresh Rose blossoms. It must be free from empyreuma, mustiness or mucoid growths.

IMPURITIES.—Metallic impurities.

Preparations

1. **Aqua Rosæ.**—Rose Water. Abv.—Aq. Ros. Stronger Rose Water and Distilled Water, of each, one volume.

2. **Unguentum Aquæ Rosæ.**—Ointment of Rose Water. Abv.—Ung. Aq. Ros. *Synonym.*—Cold Cream. Spermaceti, 125; White Wax, 120; Expressed Oil of Almond, 560; Sodium Borate, 5; Stronger Rose Water, 190.

For the Therapeutics of Rose *see* p. 639.

CLASS IV.—ACTING CHIEFLY ON THE KIDNEYS AND THE GENITO-URINARY TRACT

Oil of Juniper, Buchu, Copaiba, Oil of Thyme, Thymol, Cubeb, Oil of Santal

OLEUM JUNIPERI

OIL OF JUNIPER. Abv.—Ol. Junip. A volatile oil distilled from the ripe fruit of *Juniperus communis* Linné (Fam. *Pinaceæ*). *Habitat.*—North America throughout Canada, the Northern United states, and in the Rocky Mountains south to New Mexico.

CHARACTERS.—A colorless or faintly green or yellow liquid, having the characteristic odor and taste of Juniper fruit, Sp. gr., 0.854 to 0.879 at 25°C (77°F.). *Solubility.*—In 4 volumes of Alcohol with not more than a slight cloudiness.

COMPOSITION.—Oil of Juniper is composed chiefly of terpenes, which are mostly *Pinene* (*see* p. 216) and Cadinene.

Dose, 0.2 mil (3 ♏).

Preparations

1. **Spiritus Juniperi.**—Spirit of Juniper. Abv.—Sp. Junip. Oil of Juniper, 50; Alcohol, to 1000.

Dose, 2 mils (30 ♏).

2. **Spiritus Juniperi Compositus.**—Compound Spirit of Juniper. Abv.—Sp. Junip. Co. Oil of Juniper, 8; Oil of Caraway, 1; Oil of Fennel, 1; Alcohol, 1400; Water to 2000.

Dose, 10 mils (2½ fl. dr.).

For the Therapeutics of Oil of Juniper *see* p. 573.

BUCHU

BUCHU. *Synonym.*—Bucco. The dried leaves of *Barosma betulina* (Thunberg) Bartling et Wendland known as Short Buchu; or of *Barosma serratifolia* (Curtis) Willdenow, known as Long Buchu (Fam. *Rutaceæ*), without the presence or admixture of more than 10 per cent. of stems or other foreign matter.

Barosma betulina.—Rhomboidally ovate or obovate; from 9 to 25 mm. in length and from 4 to 13 mm. in breadth; summit obtuse, and recurved; margin somewhat

serrate or finely dentate with an oil gland at the base of each tooth; the base more or less wedge-shaped; color varying from a vivid green to yellowish-green, occasionally a few olive-gray leaves; glandular-punctate; both surfaces papillose; under surface longitudinally striate; texture coriaceous; petiole 1 mm. in length; odor and taste characteristic, aromatic and mint-like.

Barosma serratifolia.—Linear lanceolate, from 2.5 to 4 cm. in length and from 4 to 6 mm. in breadth; summit somewhat rounded or truncate with an oil gland at the apex; margin sharply serrate and glandular; otherwise resembling Short Buchu. *Resembling Buchu.*—Senna and Uva Ursi, which have entire leaves.

IMPURITY.—Leaves of *Emplanum serrulatum*, which have no glands.

COMPOSITION.—The chief constituents are—(1) A yellowish-brown volatile oil, from the glands. (2) *Diosphenol*, $C_{10}H_{16}O_2$ a stearopten, in solution in a liquid hydrocarbon. The stearopten is deposited on exposure to air. (3) *Barosmin*, a glucoside, soluble in alcohol (scarcely so, if cold) and in ether, volatile oils, dilute acids and alkalies. (4) Rutin, a bitter principle. (5) Mucilage.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Buchu.—Fluidextract of Buchu. Abv.—Fldext. Buchu. By maceration and percolation with Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

For the Therapeutics of Buchu *see* p. 570.

COPAIBA

COPAIBA. *Synonyms.*—Balsam of Copaiba. Copaiva. An oleoresin derived from South American species of *Copaiba* (Fam. *Leguminosæ*). This is not a true balsam because it does not contain cinnamic or benzoic acid. *Habitat.*—Brazil, Venezuela and New Granada.

CHARACTERS.—A pale yellow to brownish-yellow, more or less viscid liquid, either without fluorescence or with only a slightly greenish fluorescence; having a peculiar, aromatic odor and a persistent, bitter and acrid taste. Sp. gr., 0.940 to 0.995 at 25°C. (77°F.). *Solubility.*—Insoluble in water and partly soluble in Alcohol; soluble, showing not more than a slight opalescence, in Dehydrated Alcohol, Carbon Disulphide, Petroleum Benzin, or in fixed or volatile oils; completely soluble in Ether and Chloroform.

COMPOSITION.—The chief constituents are—(1) *The volatile oil*, 48 to 85 per cent. (2) *The Resin*, 15 to 52 per cent., which exists dissolved in the oil. It consists of: (a) *Copaivic Acid*, $C_{20}H_{30}O_{22}$, the chief constituent, a crystalline Resin, with a faint odor, a bitter taste, insoluble in water, easily soluble in Dehydrated Alcohol and Ammonia; and (*b*) a non-crystallizable, viscid Resin.

IMPURITIES.—Turpentine, detected by the smell on heating; fixed oils (these leave a greasy ring around the resinous stain when heated on paper); Gurjun balsam, which coagulates at 132°C. (270°F.), while Copaiba does not; paraffin or fatty oils; resin.

Dose, 1 mil. (15 ♏).

Copaiba may be suspended in Mucilage of Acacia, 45 mils (1½ fl. oz.) for every 30 mils (1 fl. oz.) of Oleoresin of Copaiba, or in yolk of egg. Cinnamon or Peppermint Water, with Tincture of Bitter Orange Peel or of Ginger, covers the taste. It may be dissolved in water with the aid of Liquor Potassii Hydroxidi, with which it forms a soap, or it may be administered in capsules. For the Therapeutics of Copaiba *see* p. 577.

OLEUM THYMI

OIL OF THYME.—Abv.—Ol. Thymi. A volatile oil distilled from the flowering plant of *Thymus vulgaris* Linné (Fam. *Labiatæ*), and containing not less than 20 per cent., by volume, of phenols. *Habitat.*—Southern France.

CHARACTERS.—A colorless or red liquid, having a characteristic odor and taste. Sp. gr., 0.894 to 0.930 at 25°C (77°F.). *Solubility.*—In 2 volumes of 80 per cent. Alcohol.

COMPOSITION.—Its chief constituents are: (1) *Cymene*, $H_{10}C_{14}$. (2) *Thymene*, $C_{16}H_{16}$. (3) *Thymol* (*see* below).

IMPURITY.—Phenol.

Dose, 0.2 mils (3 ♏).

THYMOL.—Thymol. $C_{10}H_{14}O = 150.11$. A phenol [$C_6H_3(CH_3)(OH)(C_3H_7$ 1:3:4] occurring in the volatile oil of *Thymus vulgaris* Linné (Fam. *Labiatæ*), and in some other volatile oils. *Habitat.*—Southern Europe, cultivated; United States, west to Texas and Colorado, in sandy fields; India, Persia, Egypt.

SOURCE.—Thymol is separated from the terpenes in the volatile oils by fractional distillation, agitated with solution of Sodium Hydroxide to remove more of the terpenes and cooled. The compound of Sodium Hydroxide and Thymol is decomposed by Hydrochloric Acid, and Thymol is re-crystallized from an alcoholic solution.

CHARACTERS.—Large, colorless, translucent rhombic prisms, having an aromatic thyme-like odor, and a pungent, aromatic taste, with a very slight caustic effect upon the lips. Sp. gr., as a solid, it is heavier than water, but when liquefied by fusion it is lighter than water. When triturated with about equal quantities of Camphor, Menthol, or Hydrated Chloral, it liquefies. *Solubility.*—In 1010 parts of water, in about 1 part of Alcohol, 1.5 parts Ether, 0.7 part of Chloroform, and in 1.7 parts of Olive Oil; soluble in Glacial Acetic Acid or in fixed or volatile oils.

IMPURITIES.—Phenol, inorganic impurities.

Dose (antiseptic), **0.125 gm. = 125 milligm. (2 gr.)**; (anthelmintic) **1 gm. = 15 gr., per day.**

Thymol is used to make Thymolis Iodidum.

For the Therapeutics of Oil of Thyme *see* p. 333.

CUBEBA

CUBEB.—The dried, fully-grown, unripe fruits of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*), without the presence or admixture of more than 5 per cent. of tems or other foreign matter. *Habitat.*—Java; cultivated.

CHARACTERS.—Upper portion globular, from 3 to 6 mm. in diameter, with a straight, slender stem-like portion, from 3 to 7 mm. in length; pericarp externally grayish- brownish- or bluish-black; coarsely reticulate; about 0.3 mm. in thickness, easily cut, 1-locular, 1-seeded; the immature seed attached at the base of the pericarp; odor aromatic, characteristic; taste strongly aromatic and pungent. *Resembling Cubeb.*—Pepper and Pimenta; neither has a stalk.

COMPOSITION.—The chief constituents are—(1) *The volatile oil*, 5 to 15 per cent. (*see* below). (2) *The Oleoresin*, 6 per cent. (*see* below), which contains *Cubebin*, a white, crystalline, odorless substance, and *Cubebic Acid*. (3) A little Piperine.

Dose, 1 gm. (15 gr.).

Preparations

1. **Oleoresina Cubebæ.**—Oleoresin of Cubeb. Abv.—Oleores. Cubeb. By percolation with Alcohol; distil off, and evaporate the Alcohol. The waxy and crystalline precipitate, which is deposited after this preparation has been standing for some time, should be rejected, the liquid portion only being used.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

2. **Trochisci Cubebæ.**—Troches of Cubeb. Abv.—Troch. Cubeb. Oleoresin of Cubeb, 2; Oil of Sassafras, 1; Extract of Glycyrrhiza, 25; Acacia, 12 gm.; Syrup of Tolu, sufficient quantity to make 100 troches. Each troche contains 0.02 gm.; ⅓ gr. of the Oleoresin.

OLEUM CUBEBÆ.—Oil of Cubeb. Abv.—Ol. Cubeb. A volatile oil distilled from the unripe fruit of *Piper Cubeba* Linné filius (Fam. *Piperaceæ*).

CHARACTERS.—A colorelss or a pale green or a yellowish-green liquid, having the characteristic odor and taste of Cubeb. Sp. gr., 0.905 to 0.925 at 25°C. (77°F.). An alcoholic solution of the oil is neutral to litmus paper.

COMPOSITION.—The chief constituents are—(1) *Cubeb Camphor*, $C_{15}H_{26}O$, a stearopten. (1) Two oils, $C_{15}H_{24}$. (3) A small amount of a terpene.

Dose, 0.5 mil (8 ♏).

For the Therapeutics of Cubeb *see* p. 579.

OLEUM SANTALI

OIL OF SANTAL. Abv.—Ol. Santal. *Synonym.*—Oil of Sandalwood. A volatile oil distilled from the wood of *Santalum album* Linné (Fam. *Santalaceæ*), yielding not less than 90 per cent. of alcohols, calculated as Santalol ($C_{15}H_{26}O$ = 222.21). *Habitat.*—Southern India.

CHARACTERS.—A pale yellow, somewhat thick liquid, having the characteristic odor and taste of Sandalwood. Sp. gr., 0.965 to 0.980 at 25°C. (77°F.). *Solubility.*—In 5 volumes of 70 per cent. Alcohol.

COMPOSITION.—Chiefly *Santalol*, $C_{15}H_{26}O$, an alcohol.

IMPURITIES.—Chlorinated products and other varieties of Sandalwood Oil. The latter are detected by means of polarization. The official oil is lævorotatory; its optical rotation should not be less than—15° nor more than—20° in a 100 mm. tube, at a temperature of 25°C. (77°F.).

Dose, 0.5 mil. (8 ♏).
For the Therapeutics of Oil of Santal *see* p. 580.

CLASS V.—ACTING CHIEFLY ON THE SKIN

Oil of Turpentine, Rosin, Tar, Oil of Cade, Oil of Dwarf Pine Needles, Mustard, Oil of Cajuput, Eucalyptus, Oil of Rosemary, Arnica

OLEUM TEREBINTHINÆ

OIL OF TURPENTINE.—Abv.—Ol. Tereb. *Synonym.*—Spirit of Turpentine. A volatile oil distilled with water from the concrete Oleoresin obtained from *Pinus palustris* Miller or from other species of *Pinus* (Fam. *Pinaceæ*). *Habitat.*—United States; Northern Europe,

CHARACTERS.—A colorless liquid, having a characteristic odor and taste, both of which become stronger and less pleasant on aging and exposure to the air. Sp. gr., 0.860 to 0.870 at 25°C. (77°F.). Dissolves Resins (the solution forming varnish), Wax, Sulphur Phosphorus, and Iodine. *Solubility.*—In 5 volumes of Alcohol. Oil of Turpentine is an oxidizing agent; it readily absorbs Oxygen, and becomes converted into an Oleoresin. French Oil of Turpentine is lævorotatory, some of it comes from *Pinus maritima;* English Oil of Turpentine, which mostly comes from America, and Russian Oil of Turpentine are dextrorotatory.

COMPOSITION.—Oil of Turpentine is a mixture of (1) several isomeric hydrocarbons (*terpenes*), all having the formula $C_{10}H_{16}$. The principal ones found in the oil are: *Pinene, phellandrene, limonene,* and *dipentene.* They vary in their boiling points and the direction in which they rotate the plane of polarization. The principal terpene in American oil of turpentine is dextropinene; in French oil of turpentine, lævopinene. (2) *Sesquiterpene,* $C_{15}H_{24}$. (3) Bornyl acetate. Many official volatile oils, viz., Oils of Lavender, Cubeb, Juniper, Peppermint, Caraway, Clove, contain various terpenes, all iosmeric, and all having the formula, $C_{10}H_{16}$. An oxidation product of terpene is Camphor (*see* p. 139), and there are others which are not official.

IMPURITIES.—Rosin, paraffin oils, petroleum, petroleum benzin, and similar hydrocarbons.

INCOMPATIBLES.—Bromine, chlorine, iodine water.

Two parts of mucilage, with thorough trituration, will emulsify 1 part of Oil of Turpentine with 16 parts of water.

Oil of Turpentine is contained in Ceratum Cantharides.

Preparation

Linimentum Terebinthinæ.—Turpentine Liniment. Abv.—Lin. Tereb. Oil of Turpentine, 350; Rosin Cerate, 650. By melting and mixing.

OLEUM TEREBINTHINÆ RECTIFICATUM.—Rectified Oil of Turpentine. Abv.—Ol. Tereb. Rect.

SOURCE.—Oil of Turpentine; Solution of Sodium Hydroxide, each, a sufficient quantity. By shaking and distillation and filtration.

CHARACTERS.—A colorless liquid, which conforms to the properties and tests under Oleum Terebinthinæ, specific gravity excepted. Sp. gr., 0.856 to 0.865 at 25°C. (77°F.).

Dose, 0.3 mil (5 ♏).

Preparation

Emulsum Olei Terebinthinæ.—Emulsion of Oil of Turpentine. Abv.—Emuls. Ol. Tereb. Rectified Oil of Turpentine, 15; Expressed Oil of Almond, 5; Syrup, 25; Acacia, 15; Water to 100; The Acacia and the Oils are thoroughly shaken together, 30 mils of water is then incorporated by vigorous shaking. When the Oil has been completely emulsified, the Syrup and the rest of the water are added in several portions, with shaking after each addition.

Dose, 2 mils (½ fl. dr.).

For the Therapeutics of Oil of Turpentine *see* p. 479.

RESINA

ROSIN. *Synonym.*—Colophony. The residue left after distilling the Volatile Oil from the concrete Oleoresin obtained from *Pinus palustris* Miller and from other species of *Pinus* (Fam. *Pinaceæ*).

CHARACTERS.—Usually in sharp, angular, translucent, amber-colored fragments, frequently covered with a yellow dust, brittle at ordinary temperature; fracture shiny and shallow-conchoidal; odor and taste slightly terebinthinate. Sp. gr., 1.070 to 1.090 at 25°C. (77°F.). *Solubility.*—Freely in Alcohol, Ether, Benzene, Glacial Acetic Acid, or fixed or volatile oils; it is dissolved by solutions of the fixed alkali hydroxides.

COMPOSITION.—Rosin contains *Abietic Acid Anhydride*, $C_{44}H_{64}O_6$, 80 to 90 per cent.

INCOMPATIBLES.—Menthol, phenyl salicylate, phenol, thymol, ethyl carbamate.

Rosin is contained in Ceratum Cantharides.

Preparations

1. **Ceratum Resinæ.**—Rosin Cerate. Abv.—Cerat. Res. *Synonym.*—Basilicon Ointment. Rosin, 350; Yellow Wax, 150; Lard, 500.

Rosin Cerate is contained in Linimentum Terebinthinæ.

2. **Emplastrum Resinæ.**—Rosin Plaster. Abv.—Emp. Res. *Synonyms*—Rosin Adhesive Plaster. Adhesive Plaster. Rosin, 140; Lead Plaster, 800; Yellow Wax, 60. By melting, mixing, and straining.

3. **Emplastrum Elasticum.**—Rubber Plaster. Abv.—Emp. Elast. *Synonym.*—Rubber Adhesive Plaster. A mixture of rubber, resins and

waxes, with a filler of an absorbent powder, such as orris root, or starch, mechanically mixed and spread upon cotton cloth or other fabric.

For the Therapeutics of Rosin *see* p. 485.

PIX LIQUIDA

TAR. Abv.—Pix. Liq. *Synonym.*—Pine Tar. A product obtained by the destructive distillation of the wood of *Pinus palustris*, Miller, or of other species of *Pinus* (Fam. *Pinaceæ*). *Habitat.*—United States.

CHARACTERS.—Semi-liquid, viscid, blackish-brown, non-crystalline, translucent in thin layers, becoming granular and opaque with age; odor empyreumatic, terebinthinate; taste sharp and empyreumatic. *Solubility.*—Miscible with Alcohol, Ether, Chloroform, Glacial Acetic Acid or fixed or volatile oils. It is heavier than water and is slightly soluble in it, the solution being of a pale yellowish-brown color and having an acid reaction. On distillation it gives off an empyreumatic oil (oil of tar, *see* below), and pyroligneous acid. What remains behind is pitch, black and solid; melting in boiling water.

COMPOSITION.—Tar is a very complex substance. The chief constituents are—(1) *Oil of Turpentine* (*see* p. 216). (2) *Creosote* (*see* p. 158). (3) *Phenol* (*see* p. 105). (4) *Pyrocatechin*, or *Catechol* (*see* p. 189). (5) Acetic Acid. (6) Acetone. (7) Xylol. (8) Toluol. (9) Methyl Alcohol. (10) Resins.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

Preparations

1. **Syrupus Picis Liquidæ.**—Syrup of Tar. Abv.—Syr. Pic. Liq. Tar, 5; Alcohol, 50; Magnesium Carbonate, 10; Sugar, 850; Water, to 1000. The Tar is dissolved in Alcohol, the Magnesium Carbonate and Sugar 50; are added. After thorough trituration, water is added, and the mixture filtered. The remainder of the Sugar is dissolved in the clear filtrate by gentle heat, and, after straining, the remainder of the water is added.

Dose, 4 mils (1 fl. dr.).

2. **Unguentum Picis Liquidæ.**—Tar Ointment. Abv.—Ung. Pic. Liq. Tar 500; Yellow Wax, 150; Lard, 350.

OLEUM PICIS LIQUIDÆ RECTIFICATUM. Rectified Oil of Tar. Abv.—Ol. Pic. Liq. Rect. A rectified volatile oil distilled from Tar.

CHARACTERS.—A thick liquid having a dark, reddish-brown color, and a strong, empyreumatic odor and taste. Sp. gr., 0.960 to 0.990 at 25°C. (77°F.) *Solubility.*—Readily in Alcohol.

Dose, 0.2 mil (3 ♏).

For the Therapeutics of Tar *see* p. 483.

OLEUM CADINUM

OIL OF CADE. Abv.—Ol. Cadin. *Synonym.*—Juniper Tar Oil. An empyreumatic oil obtained by the dry distillation of the wood of *Juniperus Oxy-*

cedrus Linné (Fam. *Coniferæ*). *Habitat.*—Mediterranean districts of North Africa, Spain, Portugal and France; in waste places and on stony hill-sides.

CHARACTERS.—A dark brown, clear, thick liquid, having a tarry, empyreumatic odor and warm, faintly aromatic, and bitter taste. *Solubility.*—Almost insoluble in water, but imparts to it an acid reaction; only partially soluble in Alcohol or Petroleum Benzin; completely soluble in 3 volumes of Ether. Sp. gr., 0.980 to 1.055 at 25°C. (77°F.).

COMPOSITION.—Much the same as that of Tar.

IMPURITIES.—Rosin and Rosin Oil.

For the Therapeutics of Oil of Cade *see* p. 485.

OLEUM PINI PUMILIONIS

OIL OF DWARF PINE NEEDLES. Abv.—Ol. Pin. Pumil. A volatile oil distilled from the fresh leaves of *Pinus montana* Miller (*Pinus Pumilio* Haenke) (Fam. *Pinaceæ*). *Habitat.*—Hungary; Tyrolean Alps.

CHARACTERS.—A colorless or faintly yellowish oil having a pleasant, aromatic odor and a bitter and pungent taste. Sp. gr., 0.853 to 0.869 at 25°C. (77°F.).

COMPOSITION.—*Borneol acetate, Phellandrene, Silvestrene, Cadinene,* with but little *Pinene.*

For the Therapeutics of Oil of Dwarf Pine Needles *see* p. 483.

SINAPIS

1. SINAPIS ALBA.—White Mustard. Abv.—Sinap. Alb. *Synonym.*—Yellow Mustard. The ripe seeds of *Sinapis alba* Linné (Fam. *Cruciferæ*), without the presence or admixture of more than 5 per cent. of other seeds or other foreign matter. *Habitat.*—Asia and Southern Europe; cultivated.

CHARACTERS.—Subglobular, from 1.5 to 2.5 mm. in diameter; testa yellowish, nearly smooth; embryo yellowish, oily, with two large cotyledons; inodorous; mildly pungent, acrid.

COMPOSITION.—The chief constituents are—(1) A bland fixed oil, 20 to 25 per cent. (2) *Sinalbin,* $C_{30}H_{44}N_2S_2O_{16}$, and *Myrosin;* the latter is an enzyme, and in contact with water converts *Sinalbin,* which is a Glucoside, into a fixed pungent body, very acrid, called *Acrinyl Sulphocyanide,* C_7H_7ONCS, Glucose and *Sinapine Sulphate,* $C_{16}H_{23}NO_5H_2SO_4$.

IMPURITY.—Starch.

Dose (emetic), **10 gm.** (2½ dr.).

2. SINAPIS NIGRA.—Black Mustard. Abv.—Sinap. Nig. *Synonym.*—Brown Mustard. The ripe seeds of *Brassica nigra* (Linné) Koch (Fam. *Cruciferæ*), without the presence or admixture of more than 5 per cent. of other seeds or other foreign matter. *Habitat.*—Asia and Southern Europe; cultivated.

CHARACTERS.—Ellipsoidal or irregularly spheroidal, from 1 to 1.6 mm. in diameter; testa deep reddish-brown, sometimes yellowish-brown, and with a grayish tinge, minutely pitted or reticulate; embryo greenish-yellow, or dark yellow, oily, with two large cotyledons; odor, when dry, slight; on moistening, very irritating; taste strongly pungent and acrid.

COMPOSITION.—The chief constituents are—(1) The same fixed oil as the white seeds, about 35 per cent. (2) *Sinigrin* (which is Potassium Myronate, $C_{10}H_{81}KO_{10}NS_2$, a crystalline glucoside) and *Myrosin*, an enzyme which upon distillation with steam converts *Singrin* into Glucose, Potassium Sulphate, and the official volatile Oil of Mustard (*see* below), consisting almost entirely of *Allyl Isothiocyanate* which is not found in white Mustard.

IMPURITY.—Starch.

Dose (emetic), **10 gm. (2½ dr.).**

Resembling Black Mustard Seeds.—Colchicum seeds, which are larger and lighter.

Preparation

Emplastrum Sinapis.—Mustard Plaster. Abv.—Emp. Sinap. A uniform mixture of powdered Black Mustard (deprived of its fixed oil) and a solution of rubber, spread on paper, cotton cloth or other fabric; before it is applied, moisten it thoroughly with tepid water.

3. **OLEUM SINAPIS VOLATILE.**—Volatile Oil of Mustard. Abv.—Ol. Sinap. Vol. A volatile oil produced synthetically or obtained from the seed of *Brassica nigra* (Linné) Koch (Fam. *Cruciferæ*), freed from its fatty oil by maceration with water and subsequent distillation. It yields not less than 92 per cent. of Allyl Isothiocyanate (CH_2SCN_2=99.12). The label must state whether it has been made synthetically or obtained from Black Mustard.

CHARACTERS.—A colorless or pale yellow, strongly refractive liquid, having a very pungent and irritating odor, and an acrid taste. *Great caution should be exercised when smelling this oil; it should not be tasted except when highly diluted.* Sp. gr., 1.013 to 1.020 or 25°C. (77°F.).

IMPURITIES.—Alcohol, chloroform, petroleum, carbon disulphide, phenols, fatty oils.

Dose, 0.008 mil (⅛ ♏).

For the Therapeutics of Mustard *see* p. 486.

OLEUM CAJUPUTI

OIL OF CAJUPUT. Abv.—Ol. Cajup. A volatile oil distilled from the fresh leaves and twigs of several varieties of *Melaleuca Leucadendron* Linné and especially the variety *Melaleuca Cajeputi* Roxburgh and the variety *Melaleuca minor* Smith (Fam. *Myrtaceæ*). *Habitat.*—East Indian Islands.

CHARACTERS.—A colorless or yellowish liquid, having a peculiar, agreeable, distinctly camphoraceous odor, and an aromatic, slightly bitter taste. Sp. gr., 0.915 to 0.925. *Solubility.*—In 1 volume of 80 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Cajuputol*, $C_{10}H_{18}O$; (67 per cent.) identical with *Cineol* (*see* p. 205). (2) *Terpineol*, $C_{10}H_{18}O$. (3) Several terpenes.

IMPURITY.—Copper.

Dose, 0.5 mil (8 ♏).

For the Therapeutics of Oil of Cajuput *see* p. 488.

EUCALYPTUS

EUCALYPTUS. Abv.—Eucalypt. *Synonym.*—Blue Gum Leaves. The dried leaves of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*), collected from the older parts of the tree, without the presence or admixture of more than 3 per cent. of the stems, fruits or other foreign matter. *Habitat.*—Australia; cultivated in subtropical countries.

CHARACTERS.—Laminæ lanceolately scythe-shaped from 8 to 30 cm. in length and from 2 to 7.5 cm. in breadth; summits when present acute or acunimate; bases unequal, obtuse or more or less rounded and connected with a twisted petiole from 5 to 35 mm. in length; margins slightly uneven, revolute; coriaceous; both surfaces varying from pale yellowish-green to grayish-green more or less glaucous, glabrous, glandular-punctate and with numerous small, circular, brown dots of cork; veins of the first order anastomosing with each other and forming a line nearly parallel with the margin; odor slightly aromatic; taste aromatic, bitter and cooling.

COMPOSITION.—(1) *A volatile oil* (*see* below). (2) Cerylic Alcohol. (3) A crystallizable Fatty Acid. (4) A crystallizable Resin.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Eucalypti.—Fluidextract of Eucalyptus. Abv.—Fldext. Eucalypt. By maceration and percolation with Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).

OLEUM EUCALPYTI.—Oil of Eucalyptus. Abv.—Ol. Eucalypt. A volatile oil distilled from the fresh leaves of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*) or from some other species of *Eucalyptus*, and yielding not less than 70 per cent., by volume of Eucalyptol (Cineol) ($C_{10}H_{18}O = 154.14$), rectified by steam distillation.

CHARACTERS.—A colorless or pale yellow liquid, having a characteristic, aromatic, somewhat camphoraceous odor and a pungent, spicy, and cooling taste. Sp. gr., 0.905 to 0.925 at 25°C. (77°F.). *Solubility.*—In 4 volumes of 70 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Eucalyptol* (*see* below); (2) *Cymene*, $C_{10}H_{14}$; (3) *Eucalyptene*, $C_{10}H_{16}$; (4) Tannic Acid.

IMPURITIES.—Other oils containing large amounts of phellandrene.

INCOMPATIBLES.—Alkalies, mineral acids, metallic salts.

Dose, 0.5 mil (8 ♏).

EUCALYPTOL.—Eucalyptol. $C_{10}H_{18}O = 154.14$. *Synonym.*—Cineol. An organic compound obtained from the volatile oil of *Eucalyptus Globulus* Labillardière (Fam. *Myrtaceæ*) and from other sources.

SOURCE.—In the distillation of Eucalyptus leaves, crude Eucalyptol comes over between 170° and 178°C. (338° and 352.4°F.), and is purified by re-distillation from Caustic Potash or Calcium Chloride.

CHARACTERS.—A colorless liquid, having a characteristic, aromatic, and distinctly camphoraceous odor, and a pungent, spicy taste; it produces a cooling sensation in the mouth. Sp. gr., from 0.921 to 0.923 at 25°C. (77°F.). *Solubility.*—Very slightly in water; miscible with Alcohol, Chloroform, Ether, Glacial Acetic Acid, or fixed or volatile oils.

IMPURITIES.—Phenols, other volatile oils, saponifiable oils.

Dose, 0.3 mil (5 ♏).

For the Therapeutics of Eucalyptus *see* p. 489.

OLEUM ROSMARINI

OIL OF ROSEMARY. Abv.—Ol. Rosmar. A volatile oil distilled from the fresh flowering tops of *Rosmarinus officinalis* Linné (Fam. *Labiatæ*), yielding not less than 2.5 per cent. of Ester, calculated as Bornyl Acetate ($C_{10}H_{17}C_2H_3O_2$ = 196.16), and not less than 10 per cent. of total Borneol ($C_{10}H_{17}OH$ = 154.14). *Habitat.*—Basin of the Mediterranean; cultivated.

CHARACTERS.—A colorless or pale yellow liquid, having the characteristic odor of Rosemary, and a camphoraceous taste. Sp. gr., 0.894 to 0.912 at 25°C. (77°F.). *Solubility.*—In 10 volumes of 80 per cent. Alcohol.

COMPOSITION.—The chief constituents are—(1) *Borneol*, $C_{10}H_{18}O$, an alcohol isomeric with Geraniol (*see* p. 184). (2) The terpene, *Pinene*, $C_{10}H_{16}$, 80 per cent. (3) *Cineol*, $C_{10}H_{18}O$. (4) *Linalool* (*see* p. 204). (5) *Menthol* (*see* p. 206).

Dose, 0.2 mil (3 ♏).

Oil of Rosemary is contained in Linimentum Saponis and Tinctura Lavandulæ Composita.

For the Therapeutics of Oil of Rosemary *see* p. 492.

ARNICA

ARNICA. Abv.—Arnic. *Synonym.*—Leopardsbane. The dried flower-heads of *Arnica montana* Linné (Fam. *Compositæ*). *Habitat.*—Europe and Northern Asia; in mountainous districts.

CHARACTERS.—Consisting chiefly of the tubular and lingulate flowers, occasionally with the involucre and receptacle present; involucral bracts, narrowly, lanceolate, about 1 cm. in length, dark green and pubescent; receptacle slightly convex, deeply pitted and densely short-hairy; ray flowers bright yellow, the ligulate portion 2 cm. in length, more or less folded lengthwise, 3-toothed, 7- to 12-veined, pistillate; tubular flowers perfect, reddish-yellow, stamens without a tail-like appendage (distinguished from anthers in flowers of *Inula Helenium* Linné, which have two bristles or long tails at the base); the achenes spindle-shaped, from 5 to 7 mm. in length, dark brown, finely striate, glandular pubescent and surmounted by a pappus a little longer than the achene and composed of a single circle of nearly white barbellate bristles; odor characteristic and agreeable; taste bitter and acrid.

COMPOSITION.—(1) *Arnicin*, an amorphous, yellow, acrid, bitter principle; easily soluble in Alcohol and Ether. (2) Volatile Oil. (3) Caprylic and Capronic Acids. (4) Resin. (5) Tannic acid.

Preparation

Tinctura Arnicæ.—Tincture of Arnica. Arnica, 200; by percolation with Diluted Alcohol to 1000.

Dose, 1 mil (15 ♏).

For the Therapeutics of Arnica *see* p. 492.

GROUP XI.—The Demulcents

Olive Oil, Cottonseed Oil, Sesame Oil, Chondrus, Agar, Glycerin, Althæa, Tragacanth, Acacia, Elm, Glycyrrhiza, Linseed, Sugar, Malt, Starch.

OLEUM OLIVÆ

OLIVE OIL. Abv.—Ol. Oliv. *Synonym.*—Sweet Oil. A fixed oil obtained from the ripe fruit of *Olea europæa* Linné (Fam. *Oleaceæ*). *Habitat.*—Asia and Southern Europe; cultivated.

CHARACTERS.—A pale yellow, or light greenish-yellow, oily liquid, having a slight, peculiar odor and taste, with a faintly acrid after-taste. Sp. gr., 0.910 to 0.915 at 25°C. (77°F.) *Solubility.*—Slightly in Alcohol; but miscible with Ether, Chloroform, or Carbon Disulphide.

COMPOSITION.—The three constituents are—(1) *Olein*, 72 per cent., a fluid oil, a compound of Oleic Acid ($HC_{18}H_{33}O_2$) and Glyceryl, $C_3H_5(C_{18}H_{33}O_2)_3$. (2) *Palmitin*, 28 per cent., a solid oil, a compound of Palmitic Acid ($HC_{16}H_{31}O_2$), and Glyceryl, $C_3H_5(C_{16}H_{31}O_2)_3$. (3) *Arachin*, $C_{20}H_{40}O_2$.

IMPURITIES.—Cottonseed and other oils, especially sesame oil.

Dose, 30 mils. (1 fl. oz.).

For the Therapeutics of Olive Oil *see* p. 534.

ACIDUM OLEICUM

OLEIC ACID. Abv.—Acid. Oleic. $C_{18}H_{34}O_2$ or $C_{17}H_{33}\cdot COOH = 282.27$.

SOURCE.—An acid, obtained from fats, prepared in a sufficiently pure condition by cooling commercial Oleic Acid to about 5°C. (41°F.), then separating and preserving the liquid portion.

CHARACTERS.—A yellowish or brownish-yellow, oily liquid, having a peculiar, lard-like odor and taste free from rancidity; becoming darker and absorbing oxygen on exposure to air. Sp. gr., about 0.895 at 25°C. (77°F.). When cooled above 9°C. (48.2°F.), it does not become semi-solid, but, on further cooling to 4°C. (39.2°F.), congeals in a whitish, solid mass. *Solubility.*—Practically insoluble in water; soluble in Chloroform, Benzene, Petroleum Benzin, or in fixed or volatile oils; slightly soluble in 60 per cent. Alcohol (by volume); solubility very rapidly increasing in stronger Alcohol.

IMPURITIES.—Mineral acids, undecomposed fat, or mineral oil.

Oleic Acid is used to prepare Oleatum Hydrargyri.

For the Therapeutics of Oleic Acid *see* p. 536.

SAPO

SOAP.—Soap prepared from Olive Oil and Sodium Hydroxide. *Synonyms.*—White Castile Soap. Hard Soap.

SOURCE.—Soap is prepared from Sodium Hydroxide and Olive Oil. $3NaOH + C_3H_5(C_{18}H_{33}O_2)_3 = 2NaC_{18}H_{33}O_2$ (Hard Soap) $+ C_3H_5(OH)_3$ (Glycerin).

CHARACTERS.—A white or whitish solid, in the form of bars, hard, yet easily cut when fresh, or as a fine yellowish-white powder, having a faint, peculiar odor, free from rancidity, and a disagreeable, alkaline taste. *Solubility.*—Soluble in water and in Alcohol, more readily, however, with the aid of heat.

IMPURITIES.—Animal fats, sodium carbonate, sodium chloride, silica, metallic impurities.

Soap is contained in Extractum Colocynthidis Compositum, Pilulæ Aloes and Pilulæ Asafœtidæ.

Preparation

Linimentum Saponis.—Soap Liniment. Abv.—Lin. Sapon. *Synonym.*—Opodeldoc. Soap, 60; Camphor, 45; Oil of Rosemary, 10; Alcohol, 700; water to 1000.

Soap Liniment is contained in Linimentum Chloroformi.

SAPO MOLLIS

SOFT SOAP. Abv.—Sapo Moll. *Synonym.*—Green Soap.

SOURCE.—By heating Cottonseed Oil, 430; adding to this Potassium Hydroxide, 86; dissolved in water, 450; and Alcohol, 50; until the mixture is soluble in boiling water without the separation of oily drops, adding water to 1000.

CHARACTERS.—A soft, unctuous, yellowish-white to brownish-yellow mass, having a slight characteristic odor and an alkaline taste. *Solubility.*—In 20 parts of hot distilled water which results in a nearly clear liquid.

Preparation

Linimentum Saponis Mollis.—Liniment of Soft Soap. Abv.—Lin. Sapon. Moll. *Synonym.*—Tincture of Green Soap. Soft Soap, 650; Oil of Lavender, 20; Alcohol to 1000. By filtration.

For the Therapeutics of Soap *see* p. 537.

OLEUM GOSSYPII SEMINIS

COTTONSEED OIL. Abv.—Ol. Gossyp. Sem. A fixed oil obtained from seeds of cultivated varieties of *Gossypium herbaceum* Linné, or of other species of *Gossypium* (Fam. *Malvaceæ*). *Habitat.*—Asia and Africa; cultivated.

CHARACTERS.—A pale yellow, oily liquid, odorless or nearly odorless, and having a bland taste. Sp. gr., 0.915 to 0.921 at 25°C. (77°F.). *Solubility.*—

Slightly in Alcohol; miscible with Ether, Chloroform, Petroleum Benzin, or Carbon Disulphide.

COMPOSITION.—(1) *Olein.* (2) *Palmitin.* (3) Coloring matter.

Cottonseed Oil is used in Linimentum Camphoræ.

For the Therapeutics of Cottonseed Oil *see* p. 533.

OLEUM SESAMI

SESAME OIL. Abv.—Ol. Sesame. *Synonym.*—Teel Oil. Benne Oil. A fixed oil obtained from the seeds of one or more cultivated varieties of *Sesamum indicum* Linnè (Fam. *Pedaliaceæ*). *Habitat.*—India.

CHARACTERS.—A pale yellow, oily liquid, almost odorless and having a bland taste. *Solubility.*—Slightly soluble in Alcohol; miscible with Ether, Chloroform, Petroleum Benzin, or Carbon Disulphide. Sp. gr., 0.916 to 0.921 at 25°C. (77°F.).

COMPOSITION.—Olein, 76 per cent. Myristic, Palmitic, Stearic acids.

IMPURITIES.—Free acids, cottonseed oil.

For the Therapeutics of Sesame Oil *see* p. 536.

CHONDRUS

CHONDRUS. *Synonyms.*—Irish Moss. Carragheen. The dried plant of *Chondrus crispus* (Linné) Stackhouse or of *Gigartina mamillosa* (Goodenough et Woodward) J. Agardh (Fam. *Girgartinaceæ*). *Habitat.*—Atlantic Ocean.

CHARACTERS.—Entire plants more or less matted together, consisting of a slender stalk from which arises a series of dichotomously branching, more or less flattened segments, emarginate or deeply cleft at the tips; from 5 to 15 cm. in length, and 1 to 10 mm. in width; yellowish-white, translucent, frequently coated with calcareous deposit which effervesces with hydrochloric acid; sometimes with fruit bodies or sporangia embedded near the apex of the segments (in *Chondrus crispus*) or with sporangia borne on short tuberculated projections or stalks, more or less scattered over the upper portion of the segments (in *Gigartina mamillosa*); somewhat cartilaginous; odor slight, seaweed like; taste mucilaginous, saline.

COMPOSITION.—(1) Mucilaginous Compounds, 90 per cent. (2) Albuminoids. (3) Chlorides, sulphates and phosphates, with traces of bromides and iodides.

IMPURITIES.—Gelatin and starch.

For the Therapeutics of Chondrus *see* p. 545.

AGAR

AGAR. *Synonym.*—Agar-agar. The dried mucilaginous substance extracted from *Gracilaria* (*Spærococcus*) *lichenoides* Greville and other marine Algæ growing along the Eastern Coast of Asia, particularly several species of *Gelidium*, or *Gloiopeltis* (class *Rhodophyceæ*). *Habitat.*—Indian Ocean.

CHARACTERS.—Mostly in bundles from 40 to 60 cm. in length, consisting of thin, translucent, membraneous, agglutinated pieces from 4 to 8 mm. in width;

externally yellowish-white or brownish-white; tough when damp, brittle when dry; odor slight; taste mucilaginous. *Solubility.*—Insoluble in cold water, but slowly soluble in hot water.

IMPURITIES.—Gelatin and starch.

Dose, 10 gm. (2½ dr.).

For the Therapeutics of Agar *see* p. 546.

GLYCERINUM

GLYCERIN. *Synonym.*—Glycerol. A liquid obtained by the hydrolysis of vegetable or animal fats, or fixed oils purified by distillation, and containing not less than 95 per cent. of trihydric alcohol, $C_3H_5(OH)_3$ or $CH_2OH \cdot CHOH \cdot CH_2OH$ = 92.06.

CHARACTERS.—A clear, colorless liquid, of a thick, syrupy consistence, having not more than a slight, characteristic odor which is neither harsh nor disagreeable, sweet to the taste, and producing a sensation of warmth in the mouth; when exposed to the air, it absorbs moisture. Sp. gr., not less than 1.246. *Solubility.*—Miscible with water or Alcohol; insoluble in Ether, Chloroform, Carbon Disulphide, Petroleum Benzin, Benzene, or fixed or volatile oils.

Dose, 4 mils (1 fl. dr.).

Glycerin is contained in Gelatinum Glycerinatum, Liquor Ferri et Ammonii Acetatis, Massa Hdrargyri, Mucilago Tragacanthæ, Pilulæ Phosphori, and in many Extracta, Fluidextracta, Syrupi and Tincturæ.

Preparations

1. **Glyceritum Acidi Tannici.**—Glycerite of Tannic Acid. Abv.—Glycer. Acid. Tann. Tannic Acid, 20; Glycerin, 80.

Dose, 2 mils (30 ♏).

2. **Glyceritum Amyli.**—Glycerite of Starch. Abv.—Glycer. Amyl. Starch, 10; Water, 10; Glycerin, 80.

3. **Glyceritum Boroglycerini.**—Glycerite of Boroglycerin. Abv.—Glycer. Boroglyc. Boric Acid, 310; Glycerin to 1000.

4. **Glyceritum Hydrastis.**—Glycerite of Hydrastis. Abv.—Glycer. Hydrast. It yields not less than 1.12 per cent. nor more than 1.37 per cent. of the ether-soluble alkaloids of Hydrastis. Hydrastis, 1000, by percolation and maceration with Alcohol; distil off the Alcohol, add water, 450; filter, and to the filtrate when assayed, add Glycerin, an equal volume.

Dose, 2 mils (30 ♏).

5. **Glyceritum Phenolis.**—Glycerite of Phenol. Abv.—Glycer Phenol. *Synonym.*—Glycerite of Carbolic Acid. Liquefied Phenol, 20; Glycerin, 80.

Dose, 0.3 mil (5 ♏).

6. **Suppositoria Glycerini.**—Suppositories of Glycerin. Abv.—Suppos. Glycerin. Glycerin, 30; Monohydrated Sodium Carbonate,

0.5; Stearic Acid, 2; Water, 5. By solution with heat, pour into ten moulds. Each suppository contains 3 gm. (45 gr.). of Glycerin.

For the Therapeutics of Glycerin *see* p. 543.

ALTHÆA

ALTHÆA. *Synonym.*—Marsh Mallow Root. The root of *Althæa officinalis* Linné (Fam. *Malvaceæ*), deprived of the brown, corky layer and small roots, and carefully dried. *Habitat.*—Europe, Western and Northern Asia; naturalized in the Eastern United States and in Australia, in salt marshes; cultivated in Europe.

CHARACTERS.—Usually cut into small pieces about 5 mm. in diameter, of a uniform grayish-white color and otherwise having the characters of entire roots; occasionally entire, slenderly tapering, attaining a length of 30 cm. and a thickness of 2 cm.; externally whitish, longitudinally furrowed, frequently spirally twisted and covered with the somewhat loosened bast-fibers; fracture of bark fibrous, of wood short and granular; internally yellowish-white; bark 1 to 2 mm. thick, porous, due to mucilage cells, and separated from the slightly radiating wood by a distinct, grayish cambium zone; odor slight; taste sweetish, cumilaginous.

Resembling Althæa.—Young and peeled Belladonna roots, but these have no hair-like bast-fibers upon the surface.

COMPOSITION.—(1) *Bassorin*, 35 per cent. (2) Asparagin (1 per cent.) $C_4H_8N_2O_3+H_2O$, also known as Althein; in colorless, neutral, transparent, lustrous crystals. Sp. gr., 1.520. Soluble in 47 parts of water, acids and alkalies; by the latter it is converted into Ammonia and an organic acid. (3) Sugar, 8 per cent. (4) Pectin, 10 per cent.

Althæa is used in Massa Hydrargyri, Pilulæ Ferri Carbonatis, and Pilulæ Phosphori.

For the Therapeutics of Althæa *see* p. 546.

TRAGACANTHA

TRAGACANTH. Abv.—Trag. *Synonym.*—Gum Tragacanth. A spontaneously dried gummy exudation from the stems of *Astragalus gummifer* Labillardière, or from other Asiatic species of *Astragalus* (Fam. *Leguminosæ*). *Habitat.*—Western Asia.

CHARACTERS.—In flattened fragments varying from ribbon-shaped bands, to long and linear pieces, which may be either straight or spirally twisted and from 0.5 to 2.5 mm. in thickness, whitish to light brown in color, translucent and horny, fracture short; rendered more easily pulverizable by heating to 50°C (122°F.); inodorous; taste insipid mucilaginous. *Resembling Tragacanth.*—Squill, which is thicker and opaque.

COMPOSITION.—The chief constituents are—(1) *Bassorin*, $C_{12}H_{10}O_{10}$, 33 per cent., only slightly soluble in water, unfermentable. (2) *Arabin*, $C_{12}H_{22}O_{11}$, which resembles that of Acacia, but is precipitated by Alcohol and Ammonium Oxalate. (3) A little starch.

IMPURITIES.—Indian and other foreign gums.

INCOMPATIBLES.—Alcohol, copper sulphate, ferrous sulphate.

Tragacanth is contained in Pilulæ Ferri Carbonatis and in several Trochisci.

Preparation

Mucilago Tragacanthæ.—Mucilage of Tragacanth. Abv.—Mucil. Trag. Tragacanth, 6; Glycerin, 18; Water to 100. By heating, maceration and straining.

For the Therapeutics of Tragacanth *see* p. 542.

ACACIA

ACACIA. Abv.—Acac. *Synonym.*—Gum Arabic. The dried gummy exudation of *Acacia Senegal* Willdenow and of other African species of *Acacia* (Fam. *Leguminosæ*). *Habitat.*—Eastern Africa, principally Kordofan; Western Africa, near the river Senegal.

CHARACTERS.—In ovoid, more or less spheroidal tears, or in broken, angular fragments from 2 to 30 mm. in diameter, varying from white or yellowish-white to light amber-colored; translucent; very brittle; fractured surface glass-like, sometimes iridescent; nearly inodorous; taste insipid, mucilaginous. *Solubility.*—Insoluble in Alcohol; slowly and almost completely soluble in twice its weight of water, forming a mucilaginous liquid which has a slight, characteristic odor.

COMPOSITION.—The chief constituent is *Arabin*, $C_{12}H_{22}O_{11}$, combined with Calcium, Magnesium and Potassium salts, precipitated by Alcohol acidulated with Hydrochloric Acid.

IMPURITIES.—Starch, dextrin, sand.

INCOMPATIBLES.—Alcohol, ammonia, ether, ferric salts, lead subacetate, mineral acids, potassium tartrate, syrup of squill.

Acacia is contained in Emulsum Amygdalæ, Emulsum Olei Morrhuæ, Mistura Glycyrrhizæ Composita, Pulvis Cretæ Compositus, Pilulæ Ferri Iodidi, Pilulæ Phosphori and Trochisci Cubebæ.

Preparations

1. **Mucilago Acaciæ.**—Mucilage of Acacia. Abv.—Mucil. Acac. Acacia, 350; Distilled Water, to 1000.

Dose, 15 mils (4 fl. dr.).

2. **Syrupus Acaciæ.**—Syrup of Acacia. Abv.—Syr. Acac. Acacia, 100; Sugar, 800; Distilled Water to 1000. By solution with the aid of heat, and straining.

For the Therapeutics of Acacia *see* p. 541.

ULMUS

ELM. *Synonym.*—Slippery Elm. Elm Bark. The bark of *Ulmus fulva* Michaux (Fam. *Ulmaceæ*), deprived of the outer corky layer and dried. *Habitat.*—North America, west to Louisiana and Nebraska, in woods.

CHARACTERS.—Usually in bundles consisting of flat, oblong pieces, about 30 cm. in length and from 10 to 15 cm. in width; outer surface of a light brown or buff color, with occasional dark brown patches of adhering cork, longitudinally striate and with detachable bundles of bast-fibers, and colored blackish upon the addition of a very diluted iodine test solution; inner surface light yellowish-brown, nearly smooth and finely striate, only slightly darkened upon the addition of the same test solution; fracture fibrous with projecting bast-fibers, the broken surface porous, due to the large mucilage cells; odor distinct; taste mucilaginous.

COMPOSITION.—It contains—(1) Mucilage. (2) Tannic Acid.

For the Therapeutics of Elm *see* p. 541.

GLYCYRRHIZA

GLYCYRRHIZA. Abv.—Glycyrrh. *Synonyms.*—Liquorice Root. Licorice. The dried rhizome and roots of *Glycyrrhiza glabra typica* Regel et Herder, known as Spanish Licorice, or of *Glycyrrhiza glabra glandulifera* Regel et Herder, known as Russian Licorice (Fam. *Leguminosæ*). *Habitat.*—Southern Europe and Western Asia; cultivated.

CHARACTERS.—**Spanish Licorice** (also known as Italian, Levant, Persian, Turkish, or Arabian Licorice).—Nearly cylindrical, upper portion more or less knotty; usually in pieces from 14 to 20 cm. or more in length and from 5 to 20 mm. in thickness; externally yellowish-brown or dark-brown, longitudinally wrinkled, the thinner rhizomes often having prominent alternate buds, the thicker rhizomes having distinct corky patches; fracture coarsely fibrous; internally lemon-yellow, radiate; bark from 1 to 3 mm. in thickness; wood porous, in narrow wedges, rhizome with small pith; odor distinctive; taste sweetish and slightly acrid.

Russian Licorice.—Nearly cylindrical, somewhat tapering, sometimes split longitudinally, from 15 to 30 cm. in length and from 1 to 5 cm. in diameter; when deprived of the outer corky layer, it is externally pale-yellow; fracture coarsely fibrous; internally lemon-yellow; wood radially cleft; odor distinct; taste sweetish. *Resembling Licorice.*—Pyrethrum and Taraxacum, which are not sweet.

COMPOSITION.—The chief constituents are—(1) *Glycyrrhizin*, $C_{24}H_{36}O_9$, about 6 per cent., a yellow amorphous glucoside, probably in combination with Ammonia. With acids this yields a very bitter substance, *Glycyrrhetin*, and Glucose. (2) *Asparagin*, about 3 per cent. (3) *Glycyramin*. (4) An acrid Resin. (5) Starch.

Dose, 2 gm. (30 gr.).

Glycyrrhiza is used in Fluidextractum Sarsaparillæ Compositum, Massa Hydrargyri, Pilulæ Ferri Iodidi, and Tinctura Aloes.

Glycyrrhiza and its preparations are added to many prescriptions, generally to cover their nauseous taste. They conceal very well that of Aloes, Cascara Sagrada, Ammonium Chloride, Hyoscyamus, Senega, Senna, Turpentine, and very bitter substances, as Quinine Sulphate.

Preparations

1. **Elixir Glycyrrhizæ.**—Elixir of Glycyrrhiza. Abv.—Elix. Glycyrrh. Fluidextract of Glycyrrhiza, 125; Aromatic Elixir, 875.

2. Extractum Glycyrrhizæ.—Extract of Glycyrrhiza. Abv.—Ext. Glycyrrh.

CHARACTERS.—In flattened, cylindrical rolls, or as masses of a glossy, black color externally; fracture brittle, sharp, smooth, conchoidal; taste characteristic and sweet. Not less than 60 per cent. of it is soluble in cold water. This is the commercial Extract of Glycyrrhiza.

Extract of Glycyrrhiza is contained in Pilulæ Ferri Iodidi, Trochisci Ammonii Chloridi and Trochisci Cubebæ.

3. Extractum Glycyrrhizæ Purum.—Pure Extract of Glycyrrhiza. Abv.—Ext. Glycyrrh. Pur. Glycyrrhiza by maceration with percolation with Ammonia Water and water, and Chloroform Water and water, and evaporation.

Pure Extract of Glycyrrhiza is used in Fluidextractum Cascaræ Sagradæ Aromaticum.

4. Fluidextractum Glycyrrhizæ.—Fluidextract of Glycyrrhiza. Abv.—Fldext. Glycyrrh. By maceration and percolation with Ammonia Water, Chloroform Water, Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).

Fluidextract of Glycyrrhiza is used to prepare Syrupus Sarsaparillæ Compositus.

5. Glycyrrhizinum Ammoniatum.—Ammoniated Glycyrrhizin. Abv.—Glycyrrh. Ammon. A sweet principle, combined with Ammonia, obtained from Glycyrrhiza.

SOURCE.—Glycyrrhiza, by maceration and percolation with Water of Ammonia and Water; precipitation with Sulphuric Acid, solution with Water of Ammonia, and drying.

CHARACTERS.—Dark-brown or brownish-red scales, without odor, and having a very sweet taste. *Solubility.*—Freely in water and soluble in Alcohol.

Dose, 0.250 gm. = 250 milligm (4 gr.).

6. Mistura Glycyrrhizæ Composita.—Compound Mixture of Glycyrrhiza. Abv.—Mist. Glycyrrh. Co. *Synonym.*—Brown Mixture. Pure Extract of Glycyrrhiza, 30; Syrup, 50; Acacia, 30; Antimony and Potassium Tartrate, 0.240; Camphorated Tincture of Opium, 120; Spirit of Nitrous Ether, 30; Water, to 1000.

Dose, 10 mils (2½ fl. dr.).

7. Pulvis Glycyrrhizæ Compositus.—Compound Powder of Glycyrrhiza. Abv.—Pulv. Glycyrrh. Co. *Synonym.*—Compound Licorice powder. Senna, 180; Glycyrrhiza, 236; Oil of Fennel, 4; Washed Sulphur, 80; Sugar, 500.

Dose, 4 gm. (60 gr.).

For the Therapeutics of Glycyrrhiza *see* p. 540.

LINUM

LINSEED.—Flaxseed. The ripe seeds of *Linum usitatissimum* Linné (Fam. *Linaceæ*), without the presence or admixture of more than 3 per cent. of other

seeds or foreign matter. *Habitat.*—Levant and Southern Europe; cultivated and spontaneous in most temperate countries.

CHARACTERS.—Ovate or oblong-lanceolate, flattened, obliquely pointed at one end, from 3 to 5 mm. in length; externally chestnut-brown, very smooth and shiny, the raphe extending as a distinct, light-yellow ridge along one edge; easily cut with the finger nail, internally olive-green; oily; odor slight; taste mucilaginous and oily.

Linseed or Flaxseed Meal is light olive-brown with reddish-brown fragments; the latter very coarse. It must be free from any unpleasant or rancid odor.

COMPOSITION.—(1) A viscid, fixed oil (*see* below). (2) Mucilage, 15 per cent. in the epithelium. (3) Proteids, 25 per cent. (4) Amygdalin, in minute quantity.

OLEUM LINI.—Linseed Oil. Abv.—Ol. Lini. *Synonym.*—Oil of Flaxseed. A fixed oil expressed from Linseed. Linseed Oil which has been "boiled" should not be used.

CHARACTERS.—A yellowish, oily liquid, having a peculiar odor and a bland taste. When exposed to the air, it gradually thickens, darkens in color, and acquires a strong odor and taste. Sp. gr., 0.925 to 0.935 in 25°C. (77°F.). *Solubility.*—Slightly in Alcohol; miscible with Ether, Chloroform, Petroleum Benzin, Carbon Disulphide or Oil of Turpentine.

COMPOSITION.—It most characteristic principles are—(1) *Linolein.* (2) *Myristin.* (3) *Palmitin.* (4) Albumin, a large percentage, to which its drying properties are due.

IMPURITIES.—Free acid, rosin, rosin or mineral oils, and non-drying oils.

Dose, 30 mils (1 fl. oz.).

Linseed Oil is contained in Linimentum Calcis, and Liquor Cresolis Compositus. For the Therapeutics of Linseed *see* p. 534.

SACCHARUM

SUGAR. $C_{12}H_{22}O_{11}=342.8$. Abv.—Sacch. *Synonym.*—Sucrose. It is obtained from *Saccharum officinarum* Linné (Fam. *Gramineæ*), and from *Beta vulgaris* Linné var. *Rapa* Dumont (Fam. *Chenopodiaceæ*) and from other sources. *Habitat.*—Southern Asia; cultivated in tropical and subtropical countries.

CHARACTERS.—White, hard, dry crystals, or as a white crystalline powder, odorless, and having a sweet taste. *Solubility.*—In 0.5 part of water and in slightly over 0.2 part of boiling water; and in 170 parts of Alcohol; insoluble in Ether or Chloroform.

IMPURITIES.—Glucose, inverted sugar, insoluble salts, ultramarine, Prussian blue, calcium, sulphates and chlorides.

Preparation

Syrupus.—Syrup. Sugar, 850; Distilled Water, by solution with heat, and straining to 1000.

Syrup thus prepared has a Sp. gr. of about 1.313 at 25°C. (77°F.).

Syrup is used to prepare Elixir Aromaticum and the Compound Syrups.

For the Therapeutics of Sugar *see* p. 539.

GLUCOSUM.—Glucose. Abv.—Glucos. *Synonyms.*—Syrupy Glucose. Liquid Glucose. A syrupy product obtained by the incomplete hydrolysis of Starch, consisting chiefly in dextrose (d-glucose) ($C_6H_{12}O_6 = 180.10$) and dextrins.

SOURCE.—By boiling Starch, water and Sulphuric Acid, neutralizing with chalk, and concentrating the filtrate.

CHARACTERS.—A colorless or slightly colored, thick syrupy liquid. It is odorless or nearly so and has a sweet taste. *Solubility.*—Very soluble in water, sparingly in Alcohol.

IMPURITIES.—Free acid, starch, sulphur dioxide.

For the Therapeutics of Glucose *see* p. 540.

MALTUM

MALT. *Synonym.*—Byne. The grain of one or more varieties of *Hordeum sativum* Jessen (Fam. *Gramineæ*), partially germinated artificially, and then dried at a temperature not exceeding 55°C. (131°F.). It is capable of converting not less than five times its weight of starch into sugars.

CHARACTERS.—Yellowish or amber-colored grains; crisp when fractured; the interior surface nearly white. It has an agreeable, characteristic odor and a sweet taste due to the conversion of the starch in the seed into maltose, through the action of Diastase. Malt floats on cold water.

COMPOSITION.—It contains the ferment Diastase, which can convert starch into Dextrin and Maltose. Thus $10(C_6H_{10}O_5) + 4H_2O = 4C_{12}H_{22}O_{10}$ (Maltose) + $C_{12}H_{20}O_{10}$(Dextrin).

Preparation

Extractum Malti.—Extract of Malt. Abv.—Ext. Malt. By maceration, dilution with warm water, digestion at a temperature not exceeding 60°C. (140°F.), straining and evaporation by means of a water-bath or vacuum apparatus.

CHARACTERS.—It is a sweet, thick, brownish liquid, like honey, forming an emulsion with oils. Most specimens are too viscid for prolonged use. Sp. gr., should not be less than 1.350 nor more than 1.400 at 25°C. (77°F.).

COMPOSITION.—This varies very much. The chief constituent is *Maltose* ($C_{12}H_{22}O_{10}$); there is also some *Dextrin* ($C_{12}H_{20}O_{10}$), some Diastase (unless destroyed by boiling), albumin, inorganic salts contained in barley, and sometimes Alcohol.

Dose, 15 gm. (4 dr.).

For the Therapeutics of Malt *see* p. 538.

DIASTATUM.—Diastase. A mixture containing amylolytic emzymes obtained from an infusion of malt. It converts not less than 50 times its weight of potato starch into sugar.

CHARACTERS.—A yellowish-white, amorphous powder or in translucent scales; odorless and tasteless. It converts starch into dextrin and maltose. *Solubility.*—It is soluble in water, the solutions being more or less turbid; almost insoluble in Alcohol.

Dose, 0.5 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Diastase *see* p. 645.

AMYLUM

STARCH. Abv.—Amyl. *Synonym.*—Corn Starch. The starch separated from the grain of *Zea Mays* Linné (Fam. *Gramineæ*). *Habitat.*—Tropical Asia and Africa; cultivated in tropical and subtropical countries.

CHARACTERS.—In fine powder or irregular, angular, white masses; consisting chiefly of polygonal, rounded or spheroidal starch grains, from 0.003 to 0.035 mm. in diameter, usually with a lenticular or 3- to 4-rayed central cleft, or in the rounded grains, with a circular marking; inodorous; taste slight, characteristic. *Solubility.*—Insoluble in cold water and in Alcohol; on boiling in 15 parts of water and cooling, it yields a translucent, whitish jelly.

COMPOSITION.—Its ultimate composition is $C_6H_{10}O_5$, but it consists of a mixture of various modifications of Starch-cellulose and Starch-granulose.

Preparation

Glyceritum Amyli.—Glycerite of Starch. Starch, 10; Water 10; Glycerin, 80. By trituration, and heating with Glycerin.

For the Therapeutics of Starch *see* p. 547.

GROUP XII.—Drugs Acting on Metabolism

Guaiac, Xanthoxylum, Sarsaparilla, Mezereum, Stillingia, Sassafras

GUAIACUM

GUAIAC. The resin of the wood of *Guaiacum officinale* Linné, or of *Guaiacum sanctum* Linné (Fam. *Zygophyllaceæ*). *Habitat.*—West Indies.

SOURCE.—By melting the resin of the heartwood by fire.

CHARACTERS.—In irregular fragments or in large, nearly homogenous masses, occasionally in more or less rounded or ovoid tears enclosing fragments of vegetable tissues; externally brown, becoming greenish-gray-brown on exposure, the fractured surface having a glassy luster, the thin pieces being translucent and varying in color from reddish to yellowish-brown; odor balsamic; taste slightly acrid. *Solubility.*—Readily soluble in Alcohol, Ether, Chloroform, Creosote, and in solutions of the alkalies. *Resembling Guaiac.*—Myrrh, Scammony, Benzoin, Aloes, and Rosin, but these have no greenish tinge.

COMPOSITION.—The chief constituents are three resins—(1) *Guaiaconic Acid*, $C_{18}H_{20}O_5$ (70 per cent.). (2) *Guaiacic Acid*, resembling Benzoic Acid. (3) *Guaiaretic Acid*, $C_{20}H_{26}O_4$ (about 10 per cent.). These are insoluble in water soluble in alkalies, but precipitated on neutralization.

IMPURITY.—Rosin.

INCOMPATIBLES.—Mineral acids, spirit of nitrous ether, acacia, chlorine water, metallic salts.

Dose, 1 gm. (15 gr.).

Preparations

1. **Tinctura Guaiaci.**—Tincture of Guaiac. Abv.—Tr. Guaiac. Guaiac, 200. By maceration with Alcohol, and filtration to 1000.
Dose, 4 mils (1 fl. dr.).

2. **Tinctura Guaici Ammoniata.**—Ammoniated Tincture of Guaiac. Abv.—Tr. Guaiac. Ammon. Guaiac, 200; by maceration with Aromatic Spirit of Ammonia, and filtration to 1000.
Dose, 2 mils (30 ♏).

For the Therapeutics of Guaiac *see* p. 822.

XANTHOXYLUM

XANTHOXYLUM. Abv.—Xanthox. *Synonym.*—Prickly Ash Bark. The dried bark of *Xanthoxylum americanum* Miller, known as Northern Prickly Ash Bark or of *Xanthoxylum Clava-Herculis* Linné known as Southern Prickly Ash Bark (Fam. *Rutaceæ*). *Habitat.*—North America.

CHARACTERS.—**Northern Prickly Ash Bark.**—In transversely curved fragments or quills, from 2 15 cm. in length; bark from 0.5 to 2 mm. in thickness; outer surface light gray to brownish-gray with grayish patches, of foliaceous lichens bearing numerous small black apothecia; longitudinally wrinkled and with numerous whitish lenticels; the cork occasionally abraded, showing the yellowish or orange inner bark; inner surface yellowish-white, finely longitudinally striate and usually with numerous bright, shining crystals; fracture short, uneven; odor slight; taste bitter, acrid, becoming pungent.

Southern Prickly Ash Bark.—In transversely curved or irregular, oblong, flattened pieces, or in quills from 2 to 40 cm. in length, bark from 1 to 4 mm. inthickness; outer surface light gray to brownish-gray, marked by numerous large barnacle-shaped projections of cork, from 0.5 to 3.5 cm. in thickness, otherwise with numerous grayish patches of foliaceous lichens, bearing blackish apothecia, and numerous elliptical lenticels; inner surface light yellowish-brown to olive brown, obscurely longitudinally striate and free from crystals; odor and taste as in Northern Prickly Ash Bark. *Resembling Xanthoxylum.—Aralia spinosa*, which is nearly smooth externally, and beset with slender prickles in transverse rows.

COMPOSITION.—It contains—(1) An acrid, green oil. (2) A crystalline resin, white and tasteless. (3) An acrid, soft resin. (4) A bitter substance, probably an alkaloid. (5) Tannic acid, in small quantity.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Xanthoxyli.—Fluidextract of Xanthoxylum. Abv.—Fldext. Xanthox. By maceration and percolation with Alcohol and water, and evaporation.

Dose. 2 mils (30 ♏).

For the Therapeutics of Xanthoxylum *see* p. 823.

SARSAPARILLA

SARSAPARILLA. Abv.—Sarsap. The dried root of *Smilax medica* Chamisso and Schlechtendal, known in commerce as Mexican Sarsaparilla; or *Smilax officinalis* Kunth, or an undetermined species of *Smilax*, known in commerce as Honduras Sarsaparilla; or *Smilax ornata* Hooker filius, known in commerce as Jamaica Sarsaparilla (Fam. *Liliaceæ*). *Habitat.*—Tropical America from Mexico to Brazil.

CHARACTERS.—**Mexican Sarsaparilla.**—In loose bundles, or pressed into bales, single bundles attaining a length or 60 cm. and composed of from 20 to to 35 folded roots attached to a crown with one or more stout stems; roots from 3.5 to 6 mm. in diameter; externally grayish-brown, to dark-brown, minutely hairy, longitudinally furrowed, the furrows containing more or less of a blackish earth; fracture tough, fibrous; internally light-brown with a more or less shrunken, mealy or sometimes horny cortex surrounding the porous central cylinder, pith distinct; nearly inodorous; taste mucilaginous somewhat sweetish and acrid.

Honduras Sarsaparilla.—In more or less compact, cylindrical bundles, attaining a length of 55 cm. and a diameter from 8 to 15 cm., consisting of the long, folded roots, bound together by roots of the same plant; roots from 2 to 6 mm. in diameter; externally dark or reddish-brown, longitudinally furrowed, the furrows usually free from soil; fracture fibrous; internally consisting of a grayish-white or dark brown cortex, a light-yellow and porous central cylinder and a whitish pith; taste mucilaginous and slightly acrid.

Jamaica Sarsaparilla.—In more or less compact and somewhat flattened bundles, from 30 to 45 cm. in length and from 10 to 15 cm. in width, consisting of the folded roots loosely bound with roots of the same plant; roots from 2 to 5 mm. in diameter; internally grayish-brown to reddish-brown, longitudinally wrinkled, more or less furrowed and bearing numerous coarse fibrous rootlets; taste somewhat sweet and slightly bitter. *Resembling Sarsaparilla.*—Senega, which is twisted and keeled; Hemidesmus, which is cracked transversely.

COMPOSITION.—The chief constituents are—(1) *Parillin* also named *Smilacin*, *Parillinic Acid* and *Pariglin*, about 0.2 per cent., an acrid glucoside, soluble in hot water and Alcohol, insoluble in Ether, closely resembling, if not identical with, *Saponin*. (2) Resin. (3) Calcium Oxalate and other salts.

INCOMPATIBLES.—Alkalies, lead acetate.

Dose, 2 gm. (30 gr.).

Preparations

1. **Fluidextractum Sarsaparilla.**—Fluidextract of Sarsaparilla. Abv. —Fldext. Sarsap. By maceration and percolation with diluted Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

2. **Fluidextractum Sarsaparillæ Compositum.**—Compound Fluidextract of Sarsaparilla. Abv.—Fldext. Sarsap. Co. Sarsaparilla, 750; Glycyrrhiza, 120; Sassafras, 100; Mezereum, 30. By maceration and percolation in Glycerin, Alcohol and water and evaporation, to 1000.

Dose, 2 mils (30 ♏).

3. **Syrupus Sarsaparillæ Compositus.**—Compound Syrup of Sarsaparilla. Abv.—Syr. Sarsap. Co. Fluidextract of Sarsaparilla, 200; Fluidextract of Glycyrrhiza, 15; Fluidextract of Senna, 15; Oil of Sassafras, 0.2; Oil of Anise, 0.02; Methyl Salicylate, 0.2; Alcohol, 19.4; Sugar. 750. By mixing, filtering, dissolving the Sugar, and straining with water to 1000.

Dose, 15 mils (4 fl. dr.)

For the Therapeutics of Sarsaparailla *see* p. 823.

MEZEREUM

MEZEREUM. *Synonym.*—Mezereon. The dried bark of *Daphne Mezereum* Linné, *Daphne Gnidium* Linné or of *Daphne Laureola* Linné (Fam. *Thymeleaceæ*). *Habitat.*—Europe in mountainous regions, eastward to Siberia; spontaneous in Canada and New England.

CHARACTERS.—In flexible, tough quilled pieces or somewhat flattened strips, attaining a length of 90 cm.; from 0.3 to 1 mm. in thickness; outer surface yellowish or olive-brown (*Daphne Mezereum*) or purplish-brown (*Daphne Gnidium*) or purplish-gray (*Daphne Laureola*), smooth, numerous lenticels giving a transversely striated appearance and occasionally with numerous, circular, brownish-black apothecia; outer corky layer easily separable from the middle bark which varies from light green to olive-brown, and with more or less detached bast fibers; inner surface yellowish-white, satiny lustrous, finely striate; fracture tough, fibrous, the inner bark lamellated; odor very slight, taste at first slight, becoming gradually and increasingly pungent and acrid.

COMPOSITION.—The chief constituents are—(1) *Mezerein*, a soft, acrid resin. (2) An acrid, rubefacient, volatile oil. (3) *Daphnin*, $C_{15}H_{16}O_9+2H_2O$, a bitter glucoside in fine needles or rectangular plates. (4) Coccogin, $C_{20}H_{22}O_8$, a bitter principle.

Mezereum is contained in Fluidextractum Sarsaparillæ Compositum.

For the Therapeutics of Mezereum *see* p. 824.

STILLINGIA

STILLINGIA. Abv.—Stilling. *Synonym.*—Queen's Root. The dried roots of *Stillingia sylvatica* Linnè (Fam. *Euphorbiaceæ*). *Habitat.*—Southern United States, in sandy soil.

CHARACTERS.—When entire, terete, unequally tapering, rarely branched, usually in pieces attaining a length of 40 cm., and from 0.5 to 3 cm. in diameter; externally reddish-brown, longitudinally wrinkled; fracture very fibrous; internally the bark is light reddish-brown, thick, spongy, finely fibrous, with numerous resin cells and easily separable from the porous, radiate wood; odor distinct; taste bitter, acrid and pungent.

COMPOSITION.—(1) *Sylvacrol*, an acrid resin, soluble in Alcohol and Chloroform. (2) Probably a Glucoside. (3) Resin. (4) Volatile Oil. (5) Tannic Acid.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Stillingiæ.—Fluidextract of Stillingia. Abv.—Fldext. Stilling. By maceration and percolation with Diluted Alcohol, and evaporation.

Dose, 2 mils (30 ♏).

For the Therapeutics of Stillingia *see* p. 824.

SASSAFRAS

SASSAFRAS. Abv.—Sassaf. The bark of the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Fam. *Lauraceæ*), without the presence or admixture of more than 2 per cent. of adhering wood, collected in the early spring or autumn, deprived of the outer corky layer and dried. *Habitat.*—North America from Eastern Texas and Kansas eastward to Florida, and Ontario, in woods.

CHARACTERS.—In irregularly transversely curved or quilled pieces, from 1 to 15 cm. in length and 1 to 4 mm. in thickness; outer surface orange-brown, nearly smooth and marked with more or less irregular ridges; inner surface light to dark reddish-brown, obscurely short-striate; fracture short with a thin reddish-brown corky layer and a yellowish-white inner bark; odor, aromatic; taste slightly mucilaginous, astringent, aromatic and somewhat pungent.

COMPOSITION.—The chief constituents are—(1) A volatile oil (*see* below), about 5 per cent. (2) Sassafrid, a peculiar decomposition product of Tannic Acid. (3) Resin. (4) Tannic Acid.

Dose, 10 gm. (2½ dr.).

Sassafras is contained in Fluidextractum Sarsaparillæ Compositum.

OLEUM SASSAFRAS.—Oil of Sassafras. Abv.—Ol. Sassaf. A volatile oil distilled from the root of *Sassafras variifolium* (Salisbury) O. Kuntze (Fam. *Lauraceæ*).

CHARACTERS.—A yellow or reddish-yellow liquid, having the characteristic odor and taste of Sassafras. Sp. gr., 1.065 to 1.077 or 25°C. (77°F.). *Solubility.*—In 2 volumes of 90 per cent. Alcohol.

Dose, 0.2 mil. (3 ♏).

Oil of Sassafras is contained in Syrupus Sarsaparillæ Compositus and Trochisci Cubebæ.

For the Therapeutics of Sassafras *see* p. 824.

GROUP XIII.—Drugs Used to Kill Parasites

Aspidium, Pomegranate, Pepo, Santonin, Spigelia, Oil of Chenopodium, Staphisagria, Chrysarobin

ASPIDIUM

ASPIDIUM. *Synonym.*—Male Fern. The rhizome and stipes of *Dryopteris Filix-mas* (Linné) or of *Dryopteris marginalis* (Linné) Asa Gray (Fam. *Polypodiaceæ*), collected in the autumn, freed from the roots and dead portions of rhizome and stipes and dried at a temperature not exceeding 70°C. (158°F.). *Habitat.*—North America, Northern Asia, Europe.

CHARACTERS.—Usually with the blackish-brown layers removed; rhizome 1 to 3 cm. in thickness, cylindraceous and nearly straight, or curved and tapering toward one end, usually split longitudinally, roughly scarred with remains of the stipe-bases, or bearing several coarse longitudinal sides and grooves; stipes cylindrical, 3 to 5 cm. in length, about 6 mm. in thickness, nearly straight or somewhat curved, tapering toward one end, and with occasional elongated patches in the still-adhering blackish-brown outer layers; fracture short, pale green in the inner half, the texture rather spongy, and exhibiting in an interrupted circle, from 6 to 12 vascular bundles, each surrounded by an endodermis; odor slight; taste sweetish, astringent, bitter, acrid. Use only those portions as have retained their green color.

COMPOSITION.—The chief constituents are—(1) *Filicic acid*, $C_{35}H_{42}O_{12}$, a white, amorphous or crystalline body, said to be the active principle. (2) A fixed oil, 6 to 7 per cent. (3) *Filicin*, $C_{22}H_{40}O_{12}$, a crystalline substance, soluble in Chloroform, Benzol and fixed and volatile oils. (4) Filix-red. (5) Resins.

Dose, 4 gm. (60 gr.).

Preparation

Oleoresina Aspidii.—Oleoresin of Aspidium. Abv.—Oleores. Aspid. By percolation with Ether, distillation of the Ether, and evaporation. Oleoresin of Aspidium usually deposits, on standing, a granular, crystalline substance; this should be thoroughly mixed with the liquid portion before use.

Dose, 2 gm. (30 gr.). Caution! Single dose, once a day.

For the Therapeutics of Aspidium *see* p. 337.

GRANATUM

POMEGRANATE. Abv.—Granat. The dried bark of the stems and roots of *Punica Granatum* Linné (Fam. *Punicaceæ*), without the presence or admixture of more than 2 per cent. of wood or other foreign matter. *Habitat.*—India and Southwestern Asia; cultivated and naturalized in subtropical countries.

CHARACTERS.—The stem bark is mostly in somewhat flattened or transversely curved pieces, to some extent in quills, from 2 to 8 cm. in length; bark from 0.5 to 3.5 mm. in thickness; outer surface yellowish- to grayish-brown,

with grayish patches of foliaceous lichens with their brownish-black apothecia, longitudinally wrinkled, also marked with small, broadly elliptical lenticels with more or less abraded patches of cork; inner surface light yellow to yellowish-brown, finely striate; fracture short, smooth, inner bark yellowish-green; odor slight; taste astringent, somewhat bitter and nauseous.

The root bark is in transversely curved pieces; externally brownish-yellow to dark brown, with irregular patches of cork; internally dark yellow, the medullary rays extending nearly to the outer surface.

COMPOSITION.—The chief constituents are—(1) *Pelletierine* (*Punicine*), $C_8H_{13}ON$, ½ per cent., a colorless, oily, aromatic alkaloid, soluble in water, Alcohol, Ether and Chloroform. (2) Three allied Alkaloids, *Methyl-*, *Pseudo-*, and *Iso-punicine*. (3) Punicotannic Acid, $C_{20}H_{16}O_{13}$, 20 per cent.

INCOMPATIBLES.—Alkalies, lime water, metallic salts, gelatin.

Dose, 2 gm. (30 gr.).

Preparation

Fluidextractum Granati.—Fluidextract of Granatum. Abv.—Fldext. Granat. By percolation and maceration with Glycerin, Alcohol and water, and evaporation.

Dose, 2 mils (30 ♏).

PELLETIERINÆ TANNAS. Pelletierine Tannate.—Abv.—Pellet. Tann. A mixture in varying proportions of the tannates of four alkaloids (Punicine, Iso-punicine, Methyl-punicine, and Pseudo-punicine), obtained from *Punica Granatum* Linné (Fam. *Punicaceæ*).

CHARACTERS.—A light yellow, odorless, amorphous powder, having an astringent taste and a weak acid reaction. *Solubility.*—In 240 parts of water, 16 parts of Alcohol, and 420 parts of Ether; insoluble in Chloroform; dissolved by warm dilute acids.

IMPURITIES.—Foreign alkaloids.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

For the Therapeutics of Pomegranate *see* p. 339.

PEPO

PEPO. *Synonym.*—Pumpkin Seed. The dried ripe seeds of cultivated varieties of *Cucurbita Pepo* Linné (Fam. *Cucurbitaceæ*), without the presence or admixture of more than 5 per cent. of other substances. *Habitat.*—Tropical Asia and America; cultivated.

CHARACTERS.—Broadly elliptical or ovate, from 15 to 23 mm. in length and 2 to 3 mm. in thickness; externally yellowish-white, very smooth, occasionally with thin, transparent fragments of adhering pulp and with a shallow groove parallel to and within 1 mm. of the margin; fracture short, seed-coat consisting of a white coriaceous outer layer and a membranous inner layer occasionally of a dark green color; embryo whitish, straight, with a conical hypocotyl and two plano-convex cotyledons; slightly odorous when contused; taste bland and oily.

COMPOSITION.—(1) Fixed oil, 44 per cent. (2) An acrid Resin, considered to be the tæniafuge. (3) Two proteids (Myosin and Vitellin). (4) Fatty Acids.

Dose, 30 gm. (1 oz.).

For the Therapeutics of Pepo *see* p. 340.

SANTONINUM

SANTONIN. $C_{15}H_{18}O_3 = 246.14$. The inner anhydride or lactone of Santonic Acid obtained from *Artemisia pauciflora* (Ledebour) Weber (Fam. *Compositæ*).

Source.—By exhausting Santonica, mixed with Lime, with Diluted Alcohol, distilling off the Alcohol, and adding Acetic Acid to the residue. The precipitated Santonin is purified by dissolving it in Alcohol, treating with Animal Charcoal, and crystallizing.

CHARACTERS.—Colorless, shining, flattened rhombic prisms or as a crystalline powder; odorless, and nearly tasteless at first, but afterwards developing a bitter taste; permanent in the air, but becomes yellow on exposure to light. *Solubility.*—In 43 parts of Alcohol, 110 of Ether, and 1.7 of Chloroform at 25°C. (77°F.); very slightly soluble in water; slightly soluble in boiling water.

IMPURITIES.—Alkaloids, readily carbonizable organic impurities.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

For the Therapeutics of Santonica *see* p. 340.

SPIGELIA

SPIGELIA. *Synonym.*—Pink Root. The dried rhizome and roots of *Spigelia marilandica* Linné (Fam. *Loganiaceæ*), without the presence or admixture of more than 10 per cent. of stems or other foreign matter. *Habitat.*—Southern United States; westward to Texas and Wisconsin, in rich woods.

CHARACTERS.—Rhizome horizontal or slightly oblique, more or less flexuous, somewhat branched, from 1.5 to 5 cm. long, and from 2 to 5 mm. in diameter; externally dark brown, slightly annulate, with scars of bud-scales, the upper surface knotty from approximate stem-bases, bearing cup-shaped scars; from the lower and lateral portions arise numerous long, rather coarse, sparingly branched, brittle roots; fracture short, internally differentiated into three nearly equal zones of pith, wood and bark; odor slightly aromatic; taste bitter, pungent. *Resembling Spigelia, root.—Phlox Carolina*, but the rootlets are brownish-yellow, rather coarse, straight, and contain a straw-colored wood underneath a readily removable bark.

COMPOSITION.—(1) *Spigeline*, a volatile alkaloid. (2) A little volatile oil. (3) Bitter principle. (4) Resin.

Dose, 4 gm. (60 gr.).

Preparation

Fluidextractum Spigeliæ.—Fluidextract of Spigelia. Abv.—Fldext. Spigel. By maceration and percolation with Diluted Alcohol, and evaporation.

Dose, 5 mils (1 fl. dr.).

For the Therapeutics of Spigelia *see* p. 342.

OLEUM CHENOPODII

OIL OF CHENOPODIUM. Abv.—Ol. Chenopod. *Synonym.*—Oil of American Wormseed. A volatile oil distilled from *Chenopodium ambrosioides anthelminticum* Linné (Fam. *Chenopodiaceæ*). *Habitat.*—Naturalized in the United States.

CHARACTERS.—A colorless or pale yellowish liquid, having a characteristic disagreeable odor and taste. Sp. gr., 0.955 to 0.980 at 25°C. (77°F.). *Solubility.*—It is soluble in 8 volumes of 70 per cent. Alcohol.

Dose, 0.2 mil (3 ♏).

For the Therapeutics of Oil of Chenopodium *see* p. 343.

STAPHISAGRIA

STAPHISAGRIA. Abv.—Staphisag. *Synonym.*—Stavesacre. The ripe seeds of *Delphinium Staphisagria* Linné (Fam. *Ranunculaceæ*), without the presence or admixture of more than 2 per cent. of foreign vegetable matter. *Habitat.*—Basin of the Mediterranean; cultivated.

CHARACTERS.—Irregularly triangular, or somewhat tetrahedral, one side being convex, from 4 to 7 mm. in length and from 3 to 6 mm. in breadth; externally dark brown, becoming lighter with age, and coarsely reticulate; easily cut, showing a somewhat light brown, oily endosperm, enclosing a small, embryo at the pointed end; odor slight, disagreeable; taste intensely bitter and acrid.

COMPOSITION.—The chief constituents are—(1) *Delphinine*, $C_{32}H_{45}O_6N$, a white crystalline poisonous alkaloid, soluble in Alcohol, Ether and Chloroform, resembling Aconite in its action. (2) *Delphinoidine*, $C_{42}H_{68}O_7N_2$, an amorphous alkaloid; solubility as of Delphinine. (3) *Delphisine*, $C_{27}H_{46}O_4N_2$, a crystalline alkaloid of the same solubility, (4) *Staphisagrine*, $C_{32}H_{52}O_5N$, an alkaloid but slightly soluble in water. (5) Fixed oil, 25 per cent.

Dose, 0.06 gm. = 60 milligm. (1 gr.).

Preparation

Fluidextractum Staphisagriæ.—Fluidextract of Staphisagria. Abv.—Fldext. Staphisag. *Synonym.*—Fluidextract of Stavesacre. By maceration and percolation with Alcohol, and evaporation.

For the Therapeutics of Staphisagria *see* p. 345.

CHRYSAROBINUM

CHRYSAROBIN. Abv.—Chrysarob. *Synonyms.*—Rhein. Chrysaphan (*see* p. 160). A mixture of neutral principles extracted from Goa (or Araroba) Powder, a substance found deposited in the wood of *Vouacapoua Araroba* (Aguiar) Druce (Fam. *Leguminosæ*). *Habitat.*—Brazil.

CHARACTERS.—A brownish orange-yellow, micro-crystalline powder, tasteless, odorless, and irritating to the mucous membrane. *Solubility.*—In 385 parts of Alcohol, 30 of Benzene, 12.5 of Chloroform, 16 of Ether, 30 of Benzene, and 180 of Carbon Disulphide at 25°C. (77°F.); very slightly soluble in water, and in boiling water; it dissolves in solutions of fixed alkali hydroxides, producing a red liquid.

IMPURITY.—Chrysaphanic acid.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

Preparation

Unguentum Chrysarobini.—Chrysarobin Ointment. Abv.—Ung. Chrysarobin. Chrysarobin, 6; Benzoinated Lard, 94.

For the Therapeutics of Chrysarobin *see* p. 343.

GROUP XIV.—Drug Used for Flavoring Agent

VANILLINUM

VANILLIN. $C_8H_8O_3 = 152.06$. Methylprotocatechuic Aldehyde ($C_6H_3 \cdot O \cdot H. OCH_3 \cdot COH_4$:3:1), occurring naturally in Vanilla, or prepared synthetically.

SOURCE.—It may be prepared synthetically from several orthodihydroxybenzene derivatives.

CHARACTERS.—Fine white, or only very slightly yellowish, crystalline needles, having the odor and taste of Vanilla. *Solubility.*—In 100 parts of water; at 25°C. (77°F.); also in 16 parts water at 80°C. (176°F.); freely soluble in Alcohol, Glycerin, Ether, or Chloroform.

IMPURITY.—Acetanilid.

Dose, 0.030 gm. = 30 milligm. (½ gr.).

For the Uses of Vanilla *see* p. 827.

GROUP XV.—Drug Used for Coloring Agent

SANTALUM RUBRUM

RED SAUNDERS. Abv.—Santal. Rub. The heart-wood of *Pterocarpus santalinus* Linné filius (Fam *Leguminosæ*). *Habitat.*—Madras; cultivated.

CHARACTERS.—Usually in the form of a coarse powder, of a brownish-red or dark saffron color and nearly odorless and tasteless. *Resembling Red Saunders.*—Logwood, which is less dense.

COMPOSITION.—The chief constituents are—(1) *Santalin*, $C_{15}H_{14}O_5$, in red needles. (2) *Santal*, $C_8H_6O_3$, in colorless scales. (3) *Pterocarpin*, $C_{16}H_{16}O_4$. (4) *Homopterocarpin*, $C_{24}H_{24}O_6$, in colorless crystals.

Red Saunders is contained in Tinctura Lavandulæ Composita.

For the Uses of Red Saunders *see* p. 827.

GROUP XVI.—Drugs Whose Action is Mechanical

Purified Cotton, Pyroxylin, Oil of Theobroma, Lycopodium

GOSSYPIUM PURIFICATUM

PURIFIED COTTON. Abv.—Gossyp. Purif. *Synonym.*—Absorbent Cotton. The hairs of the seed from one or more of the cultivated varieties of *Gossypium herbaceum* Linné (Fam. *Malvaceæ*), freed from adhering impurities and linters and deprived of fatty matter. *Habitat.*—Tropical Asia and Africa.

CHARACTERS.—White, soft, fine filaments, appearing under the microscope as hollow, flattened and twisted bands, spirally striate, and slightly thickened at the edges; inodorous and almost tasteless; insoluble in ordinary solvents, but soluble in an ammonia solution of Cupric Oxide.

IMPURITIES.—Fatty matter, alkalies, acids, resins and soap.

PYROXYLINUM.—Pyroxylin. *Synonym.*—Soluble Gun Cotton. A product obtained by the action of a mixture of Nitric and Sulphuric Acids on Cotton, and consisting chiefly of Cellulose Tetranitrate, $C_{12}H_{16}(ONO_2)_4O_6 = 504.17$.

SOURCE.—Purified Cotton, 100; is immersed in a mixture of Sulphuric, 2200; and Nitric Acids, 1400; washed with a large quantity of Water, drained and dried.

CHARACTERS.—A yellowish-white, matted mass of filaments, resembling raw cotton in appearance, harsh to the touch; exceedingly inflammable, burning, when unconfined, very rapidly with a luminous flame; less explosive than Cellulose Hexanitrate. *Solubility.*—Slowly but completely in 25 parts of a mixture of 3 volumes of Ether and 1 volume of Alcohol; soluble in Acetone and in Glacial Acetic Acid and precipitated from these solutions on the addition of water.

Preparations

1. **Collodium.**—Collodion. Abv.—Collod. Pyroxylin, 40; dissolved in Ether, 750; and Alcohol, 250. By mixture of solutions and decantation.

2. **Collodium Cantharidatum.**—Cantharidal Collodion. Abv.—Collod. Canth. *Synonyms.*—Blistering Collodion. Vesicating Collodion. Cantharides, 60; Glacial Acetic Acid, 5; by percolation with Acetone, 55; evaporation and solution of residue in Flexible Collodium, 85.

3. **Collodium Flexile.**—Flexible Collodion. Collodion, 950; Camphor, 20; Castor Oil, 30.

For the Uses of Cotton *see* p. 533.

OLEUM THEOBROMATIS

OIL OF THEOBROMA. Abv.—Ol. Theobrom. *Synonym.*—Cacao Butter. A concrete fixed oil obtained from the roasted seeds of *Theobroma Cacao* Linné (Fam. *Sterculiaceæ*). *Habitat.*—South America.

CHARACTERS.—A yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste. Sp. gr., about 0.973 at 25°C. (77°F.). *Solubility.*—Freely soluble in Ether, Chloroform, or Benzene; slightly in Alcohol and soluble in boiling Dehydrated Alcohol.

COMPOSITION.—The chief constituents are—(1) *Theobromine*, an alkaloid, $C_7H_8O_2N_4$ (*see* p. 172). (2) *Stearin.* (3) *Olein.* (4) Formic, Acetic and Butyric Acid Glycerides.

IMPURITIES.—Wax, stearin, tallow.

For the Uses of Oil of Theobroma *see* p. 533.

LYCOPODIUM

LYCOPODIUM. Abv.—Lycopod. *Synonyms.*—Vegetable Sulphur. Club Moss. The spores of *Lycopodium clavatum* Linné (Fam. *Lycopodiaceæ*), without the presence or admixture of more than 2 per cent. of impurities. *Habitat.*—Europe, Asia and North America, in dry woods.

CHARACTERS.—A light yellow, very mobile powder, nearly inodorous, and tasteless. It is not wetted by the water but floats upon it; when boiled with water it sinks; when thrown into a flame, it burns with a quick flash.

COMPOSITION.—(1) Fixed oil, 47 to 49 per cent. (2) Sugar, 2 per cent. (3) A volatile base, *Methylamine*, in minute quantities.

IMPURITIES.—Pollen, starch and sand.

For the Uses of Lycopodium *see* p. 829.

DIVISION III.—DRUGS DERIVED FROM THE ANIMAL KINGDOM

GROUP I.—Drug Acting Chiefly on the Nervous System

MOSCHUS

MUSK. Abv.—Mosch. *Synonyms.*—Tonquin Musk. Deer Musk. The dried secretion from the preputial follicles of the deer, *Moschus moschiferus* Linné (Fam. *Moschidæ*). *Habitat.*—Central Asia.

CHARACTERS.—Usually in small irregular granules, not more than 2 mm. in thickness, blackish with a few brown fragments, and becoming somewhat grayish with aging; glistening and somewhat oily; odor peculiar, penetrating, powerful and persistent; taste somewhat bitter. *Solubility.*—Not less than 50 per cent. is soluble in water; not less than 10 per cent. is soluble in Alcohol.

COMPOSITION.—(1) Ammonia. (2) An acid. (3) Cholesterin. (4) Fats and Oils. (5) Wax. (6) Gelatinous and albuminous principles. The odoriferous principle has not been isolated, but it is probably a product of decomposition,

being constantly formed; complete drying destroys the odor, but it returns after water is added.

IMPURITIES.—Dried blood, rosin, starch, lead and other substances.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

Preparation

Tinctura Moschi.—Tincture of Musk. Abv.—Tr. Mosch. Musk, 5; Alcohol, 45; Water, 45; by maceration and filtration with Diluted Alcohol, to 100.

Dose, 4 mils (1 fl. dr.).

For the Therapeutics of Musk *see* p. 454.

GROUP II.—The Purgatives

Oxgall, Honey

FEL BOVIS

OXGALL.—The fresh bile of the ox, *Bos Taurus* Linné (Fam. *Bovidæ*). *Habitat.*—Domesticated.

CHARACTERS.—A brownish-green or dark green, somewhat viscid liquid, having a characteristic odor, and a disagreeable, bitter taste. Sp. gr., 1.015 to 1.025 at 25°C. (77°F.).

Preparation

Extractum Fellis Bovis.—Extract of Oxgall. Abv.—Ext. Fel. Bov. Oxgall, 800; mix with Alcohol, 1000; macerate and decant, add Alcohol, 500; to the residue, decant and add it to the previous decantation and filter the mixture, distill off the Alcohol, and evaporate to a thick extract, at 75° to 80°C. (167° to 176°F.), spread upon glass plates and dry in warm air, at not exceeding 70°C. (156.2°F.), reduce to powder and add sufficient starch, dried at 100°C. (212°F.); to make 100. *Solubility.*—Very soluble in water and in Alcohol.

Dose, 0.10 gm. = 100 milligm. (1½ gr.).

For the Therapeutics of Oxgall *see* p. 661.

MEL

HONEY.—A saccharine secretion deposited in the honey-comb by the bee, *Apis mellifera* Linné (Fam. *Apidæ*). *Habitat.*—Domesticated.

CHARACTERS.—A thick, syrupy liquid of a light yellowish or yellowish-brown color, translucent when fresh, but gradually becoming opaque and crystalline, having a characteristic odor, and a sweet, faintly acrid taste.

COMPOSITION.—The chief constituents are—(1) *Dextrose* or Grape Sugar. (2) *Glucose* or Fruit Sugar. (3) Wax. (4) Volatile oil. (5) Formic Acid, a minute quantity.

IMPURITIES.—Chlorides, sulphates, starch, dextrins, sugar, artificial or added invert sugar, azo dyes, foreign coloring matter.

Preparation

Mel Depuratum.—Clarified Honey. Abv.—Mel Depurat. Heat Honey on a water-bath, with 2 per cent. of shredded paper pulp, at not exceeding 70°C. (158°F.), remove the scum from the surface, add enough water to make up the loss incurred by evaporation, strain and add 5 per cent. by weight, of Glycerin. Sp. gr., 1.095, when diluted with twice its weight of water at 25°C. (77°F.).

Clarified Honey is contained in Massa Ferri Carbonatis, and Mel Rosæ.

For the Therapeutics of Honey *see* p. 653.

GROUP III.—The Digestants

Pepsin, Pancreatin

PEPSINUM

PEPSIN.—A mixture containing a proteolytic ferment, or enzyme, obtained from the glandular layer of the fresh stomach of the hog, *Sus scrofa*, var. *domesticus* Gray (Fam. *Suidæ*). It digests not less than 3000 times its own weight of freshly coagulated and disintegrated Egg Albumin. Pepsin of a higher digestive power may be brought to this standard by admixture with Pepsin of a lower digestive strength or with Sugar of Milk. *Habitat.*—Domesticated.

SOURCE.—The mucous membrane of a pig's stomach, dissected off and finely chopped, is macerated in water, acidulated with Hydrochloric Acid for several days, with frequent stirring. The strained liquor is decanted and Sodium Chloride mixed with it. After several hours the floating mixture is skimmed from the surface and placed in cotton cloth to drain, and finally submitted to strong pressure to get rid of the saline solution.

CHARACTERS.—Lustrous white, pale yellow or yellowish, transparent or translucent scales, grains or spongy masses, or a fine white or cream-colored, amorphous powder, free from any offensive odor, and having a slightly acid or saline taste. It is not more than slightly hygroscopic. *Solubility.*—Soluble, in about 50 parts of water, the solution being more or less opalescent; nearly insoluble in Alcohol, Ether or Chloroform.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Pepsin *see* p. 643.

PANCREATINUM

PANCREATIN. Abv.—Pancreat. *Synonym.*—Zymine. A mixture of the enzymes, consisting chiefly of Amylopsin, Trypsin and Steapsin, found in the pancreas of warm-blooded animals and obtained from the fresh pancreas of the hog, *Sus scrofa*, var. *domesticus* Gray (Fam. *Suidæ*), or of the ox, *Bos taurus*

Linné (Fam. *Bovidæ*). It converts not less than 25 times its own weight of starch into soluble carbohydrates. Pancreatin of a higher digestive power may be brought to this standard by admixture with Sugar of Milk. *Habitat.*—Domesticated.

SOURCE.—Macerate the cut-up pancreas in water acidulated with Hydrochloric Acid for forty-eight hours, add a saturated solution of Sodium Chloride, allow to stand until the Pancreatin rises to the surface; skim off this, drain in a muslin filter, wash with a less concentrated solution of salt until nearly dry, then rub up with Sugar of Milk, dry thoroughly without heat, and dilute with Sugar of Milk, until 0.60 gm. (10 gr.) will just emulsify 8 mils (2 fl. dr.) of Cod Liver Oil.

CHARACTERS.—A cream-colored, amorphous powder, having a faint characteristic, but not offensive odor. *Solubility.*—Slowly and incompletely soluble in water; insoluble in Alcohol.

Dose, 0.500 gm. = 500 milligm. (8 gr.).

For the Therapeutics of Pancreatin *see* p. 644.

GROUP IV.—The Emollients

Lard, Wool Fat, Spermaceti

ADEPS

LARD.—The purified internal fat of the abdomen of the hog, *Sus scrofa*, var. *domesticus* Gray (Fam. *Suidæ*). *Habitat.*—Domesticated.

CHARACTERS.—A soft, white unctuous solid having a faint odor and a bland taste. *Solubility.*—Insoluble in water; very slightly soluble in Alcohol; readily in Ether, Chloroform, Carbon Disulphide or Petroleum Benzin. It melts at 36° to 42°C. (98.6° to 107.6°F.), to a clear liquid, from which no aqueous layer should separate.

COMPOSITION.—(1) *Olein*, 60 per cent. (2) *Stearin.* (3) *Palmitin.* Adeps Induratus (Indurated Lard), which is ordinary lard deprived of a portion of its oil by pressure, may be used in hot climates or when the high temperature renders ordinary lard too soft for use in ointments.

IMPURITIES.—Alkalies, chlorides, free fatty acids, cottonseed and other fats.

Preparations

1. **Adeps Benzoinatus.**—Benzoinated Lard. Abv.—Adeps. Benz. Siam Benzoin, 20 Lard, 1000; by melting and straining. For use in warm temperatures 50 gm. or more, if necessary, of White Wax may replace an equal quantity of Benzoinated Lard.

2. **Ceratum.**—Cerate. Abv.—Cerat. *Synonym.*—Simple Cerate. White Wax, 300; Benzoinated Lard, 700. For use in warm temperatures 50 gm. or more, if necessary, of White Wax may replace an equal quantity of Benzoinated Lard.

3. **Ceratum Resinæ.**—Rosin Cerate. Abv.—Cerat. Res. *Synonym.*—Basilicon ointment. Rosin, 350; Yellow Wax, 150; Lard, 500. In cold weather, Lard, 530; and Yellow Wax, 120; may be used.

4. **Unguentum.**—Ointment. Abv.—Ung. *Synonym.*—Simple Ointment. White Wax, 200; Benzoinated Lard, 800. For use in warm temperatures 50 gm. or more, if necessary, of White Wax may replace an equal quantity of Benzoinated Lard.

For the Therapeutics of Lard *see* p. 531.

ADEPS LANÆ

WOOL FAT.—Abv.—Adeps. Lan. *Synonym.*—Anhydrous Lanolin. The purified fat, freed from water of the wool of sheep *Ovis Aries* Linné (Fam. *Bovidæ*). *Habitat.*—Domesticated.

SOURCE.—Sheep's wool, washed with cold water, then subjected to heat and pressure, yields impure wool fat. This is purified by melting, washing with alkali, and then washed with an acid while it is heated.

CHARACTERS.—A light-yellow, tenacious, unctuous mass, having not more than a slight odor. *Solubility.*—Insoluble in, but miscible with, about twice its weight of water; sparingly soluble in cold Alcohol; more soluble in hot Alcohol; freely soluble in Ether and in Chloroform. It melts between 38° and 42°C. (100.4° and 107.6°F.).

COMPOSITION.—(1) *Cholesterin* and Isocholesterin, 70 per cent. (2) Several fatty acids, 30 per cent.

IMPURITIES.—Water, soaps, free alkalies, chlorides, free fatty acids, glycerin, petrolatum, soluble oxidizable impurities.

ADEPS LANÆ HYDROSUS

HYDROUS WOOL FAT. Abv.—Adeps Lan. Hyd. *Synonyms.*—Lanolin. Œsypum. The purified fat of the wool of sheep, *Ovis Aries* Linné (Fam. *Bovidæ*), mixed with not less than 25 nor not more than 30 per cent. of water.

SOURCE.—Sheep's wool is treated with a weak soda solution, and the solution acidulated. The remaining wool is treated with Benzin, the liquid distilled, and the residue deprived of color by oxidizing agents, or sunlight.

CHARACTERS.—A yellowish-white or nearly white, ointment-like mass, having not more than a slight odor. *Solubility.*—Insoluble in water; with Ether or Chloroform it yields turbid solutions.

COMPOSITION.—Its chief constituents are—(1) *Cholesterin*, $C_{26}H_{43}(OH)$. (2) Ethers of Stearic, Palmitic, Oleic, and other acids.

For the Therapeutics of Wool Fat *see* p. 531.

CETACEUM

SPERMACETI. Abv.—Cetac. A concrete, fatty substance, obtained from the head of the sperm whale, *Physeter macrocephalus* Linné (Fam. *Physeteridæ*). *Habitat.*—Pacific and Indian Oceans.

CHARACTERS.—White, somewhat translucent, slightly unctuous masses with a scaly, crystalline fracture and a pearly luster, a very faint odor and a bland, mild

taste. It becomes yellowish in color and rancid on prolonged exposure to air. Sp. gr., 0.938 to 0.944 at 25°C. (77°F.). *Solubility.*—Insoluble in water, and nearly so in cold Alcohol; soluble in boiling Alcohol, in Ether, Chloroform, Carbon Disulphide, or fixed or volatile oils; only slightly soluble in cold Petroleum Benzin.

COMPOSITION.—It is mainly *Cetylic Alcohol*, $C_{16}H_{33}OH$, which in combination with *Palmitic Acid*, $HC_{16}H_{31}O_2$ forms a fat, *Cetin*, $C_{16}H_{33}C_{16}H_{31}O_2$.

IMPURITES.—Paraffin, stearic acid.

Preparation

Unguentum Aquæ Rosæ.—Ointment of Rose Water. Abv.—Ung. Aq. Ros. Spermaceti, 125; White Wax, 120; Expressed Oil of Almond, 560; Sodium Borate, 5; Stronger Rose Water, 190.

For the Therapeutics of Spermaceti *see* p. 532.

GROUP V.—Drugs Which are Used Chiefly as Foods

Cod Liver Oil, Sugar of Milk, Gelatin

OLEUM MORRHUÆ

COD LIVER OIL. Abv. Ol. Morrh. *Synonym.*—Oleum Jecoris Aselli. A fixed oil obtained from the fresh livers of *Gadus Morrhua* Linné, and of other species of *Gadus* (Fam. *Gadidæ*). *Habitat.*—North Atlantic Ocean.

SOURCE.—The fresh livers are slowly heated, and the oil is decanted from the water, and sometimes deprived of the solid fat by partial freezing.

CHARACTERS.—A pale yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a fishy taste. *Solubility.*—Very slightly soluble in Alcohol; soluble in Ether, Chloroform, Carbon Disulphide or Ethyl Acetate. Sp. gr., 0.918 to 0.922 at 25°C. (77°F.).

COMPOSITION.—The chief constituents are—(1) *Olein*, 70 per cent., which is a fluid fixed oil, and is Glycerin Oleate. (2) *Palmitin*, with some Stearin, 25 per cent. (3) Free fatty acids, as Oleic, Palmitic, Stearic. (4) *Gaduin*, $C_{25}H_{46}O_9$, a peculiar principle, very insoluble in ordinary menstrua. (5) *Morrhuol*, a crystalline substance of uncertain composition, containing Phosphorus, Iodine and Bromine. (6) Traces of Iodine and Bromine. (7) Biliary principles. The so-called alkaloids of Cod Liver Oil are decomposition products, ptomaines or cadaveric alkaloids and are found in larger quantities in the brown oils. Their existence in fresh oil obtained from healthy livers has not been demonstrated.

IMPURITIES.—Seal oil, other fish oils, free fatty acids. An oil obtained from the Candle fish (*Thaleichthys Pacificus*) is found in the markets under the name of Eulachon Oil and is sometimes sold as Cod Liver Oil.

Dose, 16 mils (4 fl. dr.).

Preparation

Emulsum Olei Morrhuæ.—Emulsion of Cod Liver Oil. Abv.—Emuls. Ol. Morrh. Rub Acacia, 125, in a mortar with Cod Liver Oil, 500, add

Water, 250, triturate, and add Syrup, 100, and Methyl Salicylate, 4 (or a suitable quantity of any other flavoring), with enough water to make 1000.

For the Therapeutics of Cod Liver Oil *see* p. 824.

SACCHARUM LACTIS

SUGAR OF MILK. Abv.—Sacch. Lact. Lactose, ($C_{12}H_{22}O_{11}+H_2O=360.19$), obtained from the whey of cow's milk.

SOURCE.—By evaporation, and purified by re-crystallization.

CHARACTERS.—White, hard, crystalline masses, or a white powder, producing a gritty sensation on the tongue; odorless and having a faintly sweet taste. Permanent in the air. It readily absorbs odors. *Solubility.*—In 4.9 parts of water and in 2.6 parts of boiling water; almost insoluble in Alcohol; insoluble in Ether or Chloroform.

IMPURITIES.—Starch, dextrin, sucrose, glucose, heavy metals.

• *Sugar of Milk is used in preparing* Pulvis Ipecacuanhæ et Opii and Trituratio Elaterini.

For the Therapeutics of Sugar of Milk *see* p. 548.

GELATINUM

GELATIN. Abv.—Gelat. The purified product from animal tissues, as skin, ligaments and bones, by treatment with boiling water.

CHARACTERS.—An amorphous solid, in sheets or flakes or in ground, powdered or shredded form, colorless or slightly yellowish, and having a very slight, characteristic odor and taste. Unalterable in the air when dry, but decomposing when moist or in solution. *Solubility.*—Insoluble in cold water, but swells and softens when immersed in it, gradually absorbing from 5 to 10 times its weight of water; soluble in hot water, Acetic Acid, or Glycerin; insoluble in Alcohol, Ether, Chlorofor,m Benzene, Carbon Disulphide, or fixed or volatile oils. Gelatin used for making capsules for medicines should contain not more than 0.15 per cent. of sulphur dioxide.

Preparation

Gelatinum Glycerinatum.—Glycerinated Gelatin. Abv.—Gelat. Glycerin. Gelatin, 100; Glycerin, 100, water, a sufficient quantity. By solution, and straining, to 200.

For the Therapeutics of Gelatin *see* p. 547.

GROUP VI.—The Organic Extracts

Desiccated Thyroids, Desiccated Suprarenals, Desiccated Hypophysis

THYROIDEUM SICCUM

DRIED THYROIDS. Abv.—Thyroid. Sicc. *Synonym.*—Desiccated Thyroid Glands. The Thyroid Glands of animals which are used for food by man,

freed from connective tissue and fat, and cleaned, dried and powdered, and containing not less than 0.17 per cent. nor more than 0.23 per cent. of Iodine (I=126.92) in thyroid combination. One part of dried thyroids corresponds to approximately 5 parts of the fresh glands. *Habitat.*—Domesticated.

SOURCE.—Remove the fat and connective tissue directly the animal is killed. Reject cystic, hypertrophied or otherwise abnormal glands. Mince, dry at 32.2° to 37.7°C. (90° to 100°F.). Powder the dried product and remove all fat by washing with petroleum spirit and again dry.

CHARACTERS.—A yellowish amorphous, powder, having a slight, characteristic odor.

COMPOSITION.—The chief constituent is a proteid, which exists in the colloid matter and is called *Iodothyrin*, or *Thyroiodin;* it contains iodine and phosphorus.

IMPURITY.—Inorganic iodine compounds.

Dose, 0.100 gm. = 100 milligm. (1½ gr.).

For the Therapeutics of Dried Thyroids *see* p. 808.

SUPRARENALUM SICCUM

DRIED SUPRARENALS. Abv.—Supraren. Sicc. *Synonym.*—Desiccated Suprarenal Glands. The Suprarenal Glands of animals which are used for food by man, cleaned, dried and powdered, and containing not less than 0.4 per cent. nor more than 0.6 per cent. of Epinephrine, the active principle of the suprarenal gland. One part of Dried Suprarenals represents approximately 6 parts of fresh glands, free from fat. If assayed biologically 1 Gm. of Dried Suprarenals contains the equivalent of 10 milligm. of lævo-methylamino-ethanocatechol. *Habitat.*—Domesticated.

CHARACTERS.—A light yellowish-brown amorphous powder, having a slight, characteristic odor; partially soluble in water.

COMPOSITION.—The active principle, known as *Adrenalin*, or *Epinephrin*, exists only in the medulla of the gland. It has been isolated in the form of a yellowish-white, stable, alkaline, micro-crystalline powder, mildly bitter, and benumbing its points of contact with the tongue. It is slightly soluble in cold water, more soluble in hot water, and readily soluble in most diluted acids and alkalies; and it forms salts, such as the tartrate, benzoate, hydrochloride and sulphate.

Dose, 0.250 gm. = 250 milligm. (4 gr.).

For the Therapeutics of Dried Suprarenals *see* p. 811.

HYPOPHYSIS SICCA

DESICCATED HYPOPHYSIS. Abv.—Hypophysis Sic. *Synonym.*—Desiccated Pituitary Body. The posterior lobe obtained from the pituitary body of cattle, cleaned, dried, and powdered.

CHARACTERS.—A yellowish or grayish, amorphous powder, having a characteristic odor. *Solubility.*—It is only partially soluble in water.

Dose, 0.030 gm. = 30 milligm. (½ gr).

Preparation

Liquor Hypophysis.—Solution of Hypophysis. Abv.—Liq. Hypophysis. *Synonym.*—Solution of the Pituitary Body. A solution containing the water-soluble principle or principles from the fresh posterior lobe of the pituitary body of cattle.

SOURCE.—Extract the finely minced material with slightly acidulated water, boil the solution for ten minutes and filter it. Sterilize this filtrate and preserve it in a sterile condition in glass containers. One mil of solution of Hypophysis, diluted 20,000 times, has the same activity on the isolated uterus of the virgin guinea-pig as has a 1 to 20,000,000 solution of beta-iminazolyl-ethylamine hydrochloride.

Dose, 1 mil. (15 ♏).

For the Therapeutics of Desiccated Hypophysis *see* p. 813.

GROUP VII.—The Serums

Antidiphtheric Serum, Antitetanic Serum

SERUM ANTIDIPHTHERICUM

ANTIDIPHTHERIC SERUM.—Diphtheria Antitoxin. Abv.—Ser. Antidiph. A fluid having the potency of not less than 250 antitoxic units per mil, separated from the coagulated blood of the horse, *Equus Caballus* Linné (Fam. *Equidæ*), or other large domestic animal, which has been properly immunized against diphtheria toxin.

SOURCE.—Diphtheria bacilli are grown in a flask containing some nutrient broth (*e.g.*, meat broth), to which 0.5 per cent. of sodium chloride and 2 per cent. of commercial peptone have been added. At the end of some weeks the bacilli are filtered off, and the fluid left contains a large amount of diphtheria toxin, and it should be of such strength that 0.10 mil (1½ ♏) of it will kill a good-sized guinea-pig. From 0.20 to 1.00 mil (3 to 15 ♏) of it is aseptically injected into the jugular vein of a horse or other appropriate animal; this produces slight symptoms. As soon as they are past a larger dose is injected, and the dose is gradually increased until 100 mils (25 fl. dr.) or more are given at each injection. This leads to the formation of a large amount of antitoxin in the blood serum. At the end of some months the animal is bled to 8 litres (quarts) in a sterilized vessel, the blood coagulates, and the antitoxic serum is put into sterilized bottles and hermetically sealed, a little phenol, cresol or other antiseptic being added to prevent decomposition.

The details may be modified, as the animals vary in their reaction to the toxin, and toxins vary in strength, but the essentials of the method remain the same.

CHARACTERS.—A yellowish or yellowish-brown, transparent or slightly turbid liquid, with sometimes a granular deposit; nearly odorless or having an odor due to the presence of the antiseptic used as a preservative.

Antidiptheric Serum gradually loses in potency, the loss in one year varying between 10 per cent. and 30 per cent. The serum must come from healthy

animals, must be sterile, must be free from toxins or other bacterial products, and must not contain an excessive amount of preservative (not more than 0.5 per cent. of phenol or cresol, when either of these is used), and the total solids must not exceed 20 per cent. Serum of a lower potency than 250 units per mil must not be sold or dispensed. Only such Sera may be sold or dispensed as have been prepared and propagated in establishments licensed by the Secretary of the Treasury of the United States. The United States law requires that each container of Serum sold or dispensed by licensed establishments shall bear upon the label, in addition to the name of the Serum, the name, address and license number of the manufacturer and the date beyond which the product cannot be expected to yield its specific results. The label must also contain the laboratory number of the Serum and the total number of antitoxic units claimed for the contents of the container.

The standard of strength, expressed in units of antitoxic power, shall be that established by the United States Public Health Service.

Dose (hypodermatic), **10,000 units**; (protective), **1000 units.**

A unit is the smallest quantity of antitoxic serum, which when mixed with a certain quantity of a standard diphtheric toxin and with it injected into the subcutaneous tissue of a healthy guinea-pig weighing from 250 to 300 gm. (8 to 10 oz.), protects the animal from death within four days.

SERUM ANTIDIPHTHERICUM PURIFICATUM.—Purified Antidiphtheric Serum. Abv.—Ser. Antidiphth. Purif. *Synonyms.*—Antidiphtheric Globulins. Concentrated Diphtheria Antitoxin. Diphtheric Antitoxin Globulins. Refined and Concentrated Diphtheria Antitoxin. A solution in physiological solution of Sodium Chloride of certain antitoxic substances obtained from the blood serum or plasma of the horse, *Equus Caballus* Linné (Fam. *Equidæ*) or other large domestic animal, which has been properly immunized against diphtheria toxin.

SOURCE.—After the serum or plasma from the immunized animal has been collected the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water; and sufficient Sodium Chloride is then added to make a solution containing from 0.6 to 0.9 per cent. of the salt. It has a potency of not less than 250 antitoxic units per mil.

CHARACTERS.— A transparent or slightly opalescent liquid, with sometimes a slight granular or ropy deposit, nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. The liquid is sometimes more or less viscous. The serum must come from healthy animals, must be sterile, must be free from toxins or other bacterial products, and must not contain an excessive amount of preservatives (not more than 0.5 per cent. of phenol or cresol, when either of these is used), and the total amount of solids must not exceed 20 per cent. Serum of a lower potency than 250 units per mil must not be sold or dispensed. It must comply with the requirements for loss of potency, control, labelling and standard of potency under Serum Antidiptheric (*see* p. 252).

Dose (hypodermatic), **10,000 units**; (protective) **1000 units.**

SERUM ANTIDIPHTHERICUM SICCUM.—Dried Antidiphtheric Serum. Abv.—Ser. Antidiphth. Sicc. *Synonym.*—Dried Diphtheria Antitoxin.

SOURCE.—It is obtained by the evaporation of either Antidiphtheric Serum or Purified Antidiphtheric Serum in a vacuum over Sulphuric Acid or other desiccating agent, or by passing over it a current of warm air freed from bacteria. It has a potency of not less than 4000 units per gram.

CHARACTERS.—It is either in the form of orange or yellowish flakes or small lumps, or as a yellowish-white powder, without odor. *Solubility.*—In 9 parts of distilled water, but the solution is opalescent, and slightly viscous; it may be dissolved more readily in larger amounts of distilled water or physiological solution of Sodium Chloride. Immediately before use the serum must be dissolved in recently boiled and cooled distilled water under the most rigid aseptic precautions. The solution must be used immediately, and if there be any serum or solution remaining, it must be discarded. Dried Antidiphtheric Serum if kept hermetically sealed, in amber-colored glass containers, free from air, at a temperature between 4.5° and 15°C. (40.9° and 59°F.), preferably in a dark place does not lose in potency, as does the liquid serum. It must comply with the requirements as established for Serum Antidiphthericum (*see* p. 252).

Dose (hypodermatic), **10,000 units**; (protective) **1000 units.**

For the Therapeutics of Antidiphtheric Serum (*see* p. 803).

SERUM ANTITETANICUM

ANTITETANIC SERUM. Abv.—Ser. Antitetan. *Synonym.*—Tetanus Antitoxin. A fluid having a potency of not less than 100 units per mil, separated from the coagulated blood of the horse *Equus Caballus* Linné (Fam. *Equidæ*), or other large domesticated animal, which has been properly immunized against tetanus antitoxin.

CHARACTERS.—A yellowish or yellowish-brown, transparent, or slightly turbid liquid with sometimes a slight granular deposit; nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. It gradually loses in potency, the loss being greater at higher than at lower temperatures. The Serum must come from healthy animals, must be sterile, must be free from toxins or other bacterial products, and must not contain an excessive amount of preservative (not more than 0.5 per cent. of phenol or cresol, when either of these is used), and the total solids must not exceed 20 per cent. Serum of a lower potency than 100 units per mil must not be sold or dispensed. Only such Sera may be sold or dispensed as have been prepared and propagated in establishments licensed by the Secretary of the Treasury of the United States. The same requirements as to labelling and standards, except as to potency, are fixed for this, as for the Antidiphtheric Serum (*see* p. 252).

Dose (hypodermatic), **10,000 units**; (protective) **1500 units.**

SERUM ANTITETANICUM PURIFICATUM.—Purified Antitetanic Serum. Abv.—Ser. Antitetan. Purif. *Synonyms.*—Antitetanic Globulins. Concentrated Tetanus Antitoxin. Refined and Concentrated Tetanus Antitoxin. Tetanus Antitoxin Globulins. A solution in physiological solution of Sodium Chloride of certain antitoxic substances obtained from the blood serum or plasma of the horse, *Equus Caballus* Linné (Fam. *Equidæ*), or other large domesticated animal, which has been properly immunized against tetanus toxin.

After the serum or plasma from the the immunized animal has been collected, the antitoxin-bearing globulins are separated from the other constituents of the serum or plasma and dissolved in water; and sufficient Sodium Chloride is then added to make a solution containing from 0.6 to 0.9 per cent. of the salt. It has a potency of not less than 100 units per mil.

CHARACTERS.—A transparent or slightly opalescent liquid, with sometimes a slight granular or ropy deposit; nearly odorless, or having an odor due to the presence of the antiseptic used as a preservative. The liquid is sometimes more or less viscous. The same requirements, except as to potency, as for Purified Antidiphtheric Serum must be complied with (*see* p. 253).

Dose (hypodermatic), 10,000 units; (protective) 1500 units.

SERUM ANTITETANICUM SICCUM.—Dried Antitetanic Serum. Abv.—Ser. Antitetan. Sicc. *Synonym.*—Dried Tetanus Antitoxin.

SOURCE.—It is obtained by the evaporation of either Antitetanic Serum or Purified Antitetanic Serum in a vacuum, over Sulphuric Acid or other desiccating agent, or by passing over it a current of warm air freed from bacteria. It has a potency of not less than 1000 units per gram.

CHARACTERS.—Either as orange or yellowish flakes or small lumps, or a yellowish-white powder, without odor. *Solubility.*—In 9 parts of distilled water, but the solution is opalescent and slightly viscous; it may be dissolved more readily in larger amounts of distilled water or physiological solution of Sodium Chloride. The same requirements as to use, keeping, labelling, and standards, except as to potency, apply to this as to Dried Antidiphtheric Serum (*see* p. 253). It is sometimes used as a dusting powder or for local application to infected wounds.

Dose (hypodermatic), 10,000 units; (protective) 1500 units.

For the Therapeutics of Antitetanic Serum *see* p. 805.

GROUP VIII.—The Vaccines

VIRUS VACCINICUM

VACCINE VIRUS. Abv.—Virus Vaccin. *Synonyms.*—Glycerinated Vaccine Virus. Smallpox Vaccine. Jennerian Vaccine. The pustules of vaccinia or cowpox from healthy vaccinated animals of the bovine species, removed and prepared under aseptic conditions.

SOURCE.—The vaccine pulp should be thoroughly rubbed up in a mortar or passed through a special grinder, strained to remove coarse particles, and made into a smooth emulsion with a Glycerin solution. It gradually loses in potency, the loss being more rapid at high than at low temperatures. It should be preserved at a temperature of between 4.5° and 15°C. (40.9° and 59°F.), protected from light.

Only such Vaccine Virus may be sold as has been prepared in establishments licensed by the Secretary of the Treasury of the United States. No Vaccine Virus shall be used from any animal having a communicable disease, or suspected of having a communicable disease, other than vaccinia; animals used for propagat-

ing Vaccine Virus must be under daily veterinary examination for a period of not less than seven days before vaccination, and as soon as the vaccine pulp is removed a necropsy must be made on each animal and permanent records kept. Each lot of Vaccine Virus shall be examined to determine its freedom from pathogenic micro-organisms and a special examination must be made of each lot to determine the absence of tetanus spores or toxin, and permanent records must be kept of these examinations. The Virus must be marketed in sterile containers that comply with the requirements of the law and the regulations of the United States Public Health Service. Each package shall bear upon the label the name, address, and license number of the manufacturer and the date beyond which the contents cannot be expected to yield their specific results. The label should also contain the laboratory number of the Virus.

For the Therapeutics of Vaccine Virus *see* p. 806.

GROUP IX.—Drug Used for Coloring Agent

COCCUS

COCHINEAL. *Synonym.*—Red Scale Insect. The dried female of the insect *Coccus cacti* Linné (Fam. *Coccidæ*), enclosing the young larvæ. *Habitat.*—Mexico and Central America; upon *Opuntia cochinillifera* Miller and other species (Fam. *Cactaceæ.*)

CHARACTERS.—Somewhat ovate in outline, convex above, concave beneath, from 3.5 to 7 mm. in length, consisting of from 9 to 12 segments; externally grayish-purple or grayish; in the shell-like, somewhat horny abdomen lie numerous larvæ less than 1 mm. in diameter; the mature larvæ with antennæ consisting of eight joints, three pairs of legs, the lower having from 6 to 8 segments, and a characteristic beak or rostrum composed of 4 thread-like parts which pair off into two coils. It is easily pulverizable, and yields a dark red powder with a characteristic odor, and slightly bitter taste. When masticated it colors the saliva red, due to the coloring principle, carminic acid, which is soluble in water, Alcohol or alkalies and slightly soluble in Ether.

COMPOSITION.—The chief constituents are—(1) *Carminic Acid*, $C_{17}H_{18}O_{16}$, 10 per cent. (2) Coccerin, a wax. (3) Fat, consisting of myristin, and fatty acids. Sulphuric acid and several other reagents precipitate from its decoction the well-known coloring matter, carmine.

Cochineal is contained in Tinctura Cardamomi Composita.

For the Uses of Cochineal *see* p. 827.

GROUP X.—Drugs Whose Action is Mechanical

Prepared Suet, Stearic Acid, Wax, Cantharides

SEVUM PRÆPARATUM

PREPARED SUET. Abv.—Sev. Præp. *Synonym.*—Mutton Suet. The internal fat of the abdomen of the sheep, *Ovis Aries* Linné (Fam. *Bovidæ*), purified by melting and straining. *Habitat.*—Domesticated.

CHARACTERS.—A white, solid fat, nearly inodorous, and having a bland taste when fresh, but becoming rancid on prolonged exposure to the air. *Solubility.*—Insoluble in water or cold Alcohol; it dissolves in 44 parts of boiling Alcohol, in about 60 parts of Ether, and slowly in 2 parts of Purified Petroleum Benzin.

COMPOSITION.—Its chief constituents are—(1) *Stearin.* (2) *Palmitin.* (3) *Olein.* (4) *Hircin.*

Prepared Suet is contained in Unguentum Hydrargyri.

For the Uses of Prepared Suet *see* p. 828.

ACIDUM STEARICUM

STEARIC ACID. Abv.—Acid. Stear. $C_{18}H_{36}O_2$ or $C_{17}H_{35}\cdot COOH = 284.29$. An acid obtained from tallow and other solid fats.

SOURCE.—By boiling the fats with soda-lye, the Stearin is decomposed, Sodium Stearate being formed with the liberation of Glycerin. $C_3H_5(C_{18}H_{35}O_2)_3 + 3NaOH = 3NaC_{18}H_{35}O_2 + C_3H_5(OH)_3$. This soap is decomposed by heating with water and Sulphuric Acid, setting free the fatty acids which are removed and purified with hot Alcohol. On cooling, Stearic Acid will separate.

CHARACTERS.—A hard, white, or yellowish-white, somewhat glossy solid, odorless or having a slight, tallow-like odor, tasteless, and permanent in the air. *Solubility.*—Almost insoluble in water; soluble in about 21 parts of Alcohol; in 2 parts of Chloroform; in 3 parts of Ether at 25°C. (77°F.); freely soluble in Carbon Disulphide or Carbon Tetrachloride.

IMPURITY.—Undecomposed fat, paraffin, mineral acids.

ZINCI STEARAS.—Zinc Stearate. Abv.—Zinc Stear. A compound of Zinc with Stearic Acid and small, but variable proportions of Palmitic Acid, containing an amount of Zinc corresponding to not less than 13 per cent. nor more than 15.5 per cent. of Zinc Oxide ($ZnO = 81.37$).

SOURCE.—Zinc Acetate or Sulphate, dissolved in water, is heated and added to Potassium Stearate, and the precipitate washed and dried.

CHARACTERS.—A very white bulky powder, tasteless, and having a faint characteristic odor. *Solubility.*—It is insoluble in water, Alcohol or Ether.

IMPURITIES.—Chlorides, alkalies, alkali earths.

For the Therapeutics of Stearic Acid *see* p. 530.

CERA

CERA FLAVA.—Yellow Wax. Abv.—Cer. Flav. *Synonym.*—Beeswax. A product obtained by melting and purifying the honey-comb of the bee, *Apis mellifera* Linné (Fam. *Apidæ*).

CHARACTERS.—A yellow to gray-brown solid, having an agreeable, honey-like odor, and faint characteristic taste. Sp. gr., 0.950 to 0.960 at 25°C. (77°F.). *Solubility.*—Insoluble in water; sparingly soluble in cold Alcohol; boiling Alcohol dissolves the Cerotic Acid and a portion of the Myrocin. It is completely soluble in Ether, Chloroform, or in fixed or volatile oils.

COMPOSITION.—The principal constituents are—(1) Hydrocarbons (probably $C_{27}H_{56}$ and $C_{54}H_{64}$) about 12 per cent. (2) *Cerin* or Cerotic Acid, $C_{27}H_{54}O_2$.

(3) *Myricin*, $C_{30}H_{61} \cdot C_{16}H_{31}O_2$, is the principal constituent. (4) An Alcohol, $C_{28}H_{57}O$, in small quantities. (5) *Cerylic Alcohol*, $C_{27}H_{56}O$.

IMPURITIES.—Fats, fatty acids, Japan wax, rosin, soap.

Yellow Wax is used in Ceratum Cantharidis, Ceratum Resinæ and Unguentum Picis Liquidæ.

CERA ALBA.—White Wax. Abv.—Cer. Alb.

SOURCE.—Made by bleaching yellow wax by exposure to moisture, air and light.

CHARACTERS.—A yellowish-white solid, somewhat translucent in thin layers, having a faint, characteristic odor; it is free from rancidity and nearly tasteless. Sp. gr., 0.950 to 0.960 at 25°C (77°F.).

COMPOSITION.—As of yellow wax.

White Wax is used in Ceratum, Unguentum, and Unguentum Aquæ Rosæ.

For the Uses of Wax *see* p. 828.

CANTHARIS

CANTHARIDES. Abv.—Canthar. *Synonyms.*—Spanish Flies. Russian Flies. The beetle, *Cantharis vesicatoria* (Linné) De Geer (Fam. *Meloideæ*, Order *Coleoptera*) yielding not less than 0.6 per cent. of Cantharidin. *Habitat.*—Southern and Central Europe, mainly on Fam. *Oleaceæ* and *Caprifoliaceæ*.

CHARACTERS.—From 15 to 25 mm. in length, 5 to 8 in breadth, oblong, somewhat compressed above; of a brilliant green or bluish-green, metallic luster, changing in different parts, especially beneath, to a golden-green; head triangular, separated into two lateral lobes by a faint median line; mandibles stout and partly concealed; antennæ filiform, of 11 conical joints, the upper ones being black; eyes comparatively small; prothorax annulate; legs with fine tarsal joints; wings membranous and brownish; elytra or wing sheaths each with two parallel lines and finely wrinkled; odor strong, disagreeable; taste slight, afterwards acrid.

COMPOSITION.—The chief constituents are—(1) *Cantharidin*, $C_{10}H_{12}O_4$, the active principle, a crystallizable body forming colorless plates, soluble in Alcohol, Ether, Acetic Ether, Glacial Acetic Acid, Chloroform, and oils. It is found especially in the generative apparatus, the eggs, and the blood. (2) A volatile oil giving the odor and said to have the same action as Cantharidin. (3) A green oil, the coloring principle, closely allied to chlorophyll. (4) Various extractives and salts.

Preparation

1. **Ceratum Cantharidis.**—Cantharides Cerate. Abv.—Cerat. Canthar. *Synonym.*—Blistering Cerate. Cantharides, 350; Glacial Acetic Acid, 25; Oil of Turpentine, 150; Yellow Wax, 175; Rosin, 175; Benzoinated lard, 200. By maceration, straining and evaporation to 1000.

2. **Collodium Cantharidatum.**—Cantharidal Collodion. Abv.—Callod. Canth. *Synonyms.*—Blistering Collodion. Vesicating Collodion. Cantharides, 60; by percolation with Acetone, 55; and Glacial Acetic Acid, 5; evaporation and solution of residue in Flexible Collodion, 85.

3. **Emplastrum Cantharidis.**—Cantharides Plaster. Abv.—Emp. Canthar. Cantharides Cerate spread upon Rosin Plaster. It should not be dispensed unless freshly prepared.

4. **Tinctura Cantharidis.**—Tincture of Cantharides. Abv.—Tr. Canthar. Cantharides 100; by percolation and maceration with Alcohol to 1000.

Dose, 0.1 mil (ɪ½ ♏).

For the Therapeutics of Cantharides *see* p. 493.

APPENDIX

ORGANIC DRUGS ACCORDING TO THEIR NATURAL ORDERS

1. The Vegetable Drugs

Family	*Name of Plant*	*Part Used*	*Name of Drug*
1. Gigartinaceæ.	Chondrus crispus.	Plant.	Irish Moss.
2. Polypodaceæ	Gigartina mamillosa.	Plant.	Irish Moss.
3. Rodophyceæ	Gracilaria (Sphærococcus) lichenoides	Mucilaginous substance	Agar
	Gelidium or Gloiopeltis (*Sp. indet.*)	Mucilaginous substance	Agar.
4. Hypocraceæ.	Claviceps purpurea.	Sclerotium.	Ergot.[1]
5. Filices.	Dryopteris Filix-mas.	Rhizome and stipes.	Male fern.
	Dryopteris marginalis.	Rhizome and stipes.	Male fern.
6. Lycopodiaceæ.	Lycopodium clavatum.	Spores.	Lycopodium.
7. Pinaceæ.	Pinus palustris.	Oil from Oleoresin.	Oil of turpentine.
	Pinus palustris.	Product from distillation of wood.	Tar.
	Pinus palustris.	Concrete oleoresin.	Rosin.
8. Coniferæ.	Juniperus communis.	Oil from fruit.	Oil of juniper.
	Juniperus Oxycedrus.	Product from distillation of wood.	Oil of cade.
9. Gramineæ.	Saccharum officinarum.	Refined sugar.	Sugar.[2]
	Zea Mays.	Starch from grain.	Starch.
	Hordeum sativum.	Grain, partially germinated.	Malt.
	Agropyron repens.	Rhizome and roots.	Triticum.
	Secale cereale.	Fungus replacing the grain.	Ergot.[3]
10. Palmæ.	Serenoa serrulata.	Fruit.	Sabal.
11. Liliaceæ.	Aloe ferox.	Juice of leaves.	Aloes.
	Aloe Perryi.	Juice of leaves.	Aloes.
	Aloe vera.	Juice of leaves.	Aloes.
	Urginea maritima.	Bulb.	Squill.
	Colchicum autumnale.	Corm.	Colchicum corm.
	Colchicum autumnale.	Seed.	Colchicum seed.
	Veratrum viride.	Rhizome and roots.	Veratrum viride.
	Asagræa officinalis.	Alkaloids from seed.	Veratrine.
	Smilax medica.	Root.	Mexican sarsaparilla.
	Smilax officinalis.	Root.	Honduras sarsaparilla.
	Smilax ornata.	Root.	Jamaica sarsaparilla
12. Zingiberaceæ.	Zingiber officinale.	Rhizomes.	Ginger.
	Elettaria Cardamomum.	Seeds.	Cardamon.
13. Orchidaceæ.	Vanilla planifolia.	Aldehyde.	Vanillin.
14. Piperaceæ.	Piper Cubeba.	Fruits.	Cubeb.
	Piper nigrum.	Fruit.	Pepper.
15. Salicaceæ.	Salix (*several species*).	Glucoside.	Salicin.
	Populus (*several species*).	Glucoside.	Salicin.
16. Betulaceæ.	Betula lenta.	Oil from bark.	Methyl salicylate.
17. Cupuliferæ.	Quercus infectoria.	Parasitic excrescences.	Nutgall.
18. Fagaceæ.	Fagus (*several species*).	Derivatives from wood-tar.	Creosote.
19. Ulmaceæ.	Ulmus fulva.	Bark.	Slippery elm.
20. Moraceæ.	Cannabis sativa or *var.* indica.	Flowering tops.	Cannabis.
	Humulus Lupulus.	Strobiles.	Hops.

[1] *See* also Family No. 9, *Gramineæ*.
[2] *See* also Family No. 24, *Chenopodiaceæ*.
[3] *See* also Family No. 4, *Hypocraceæ*.

Family	*Name of Plant*	*Part Used*	*Name of Drug*
21. Santalaceæ.	Santalum album.	Oil from wood.	Oil of santal.
22. Aristolochiaceæ.	Aristolochia reticulata.	Rhizome and roots.	Texas Serpentaria.
	Aristolochia Serpentaria.	Rhizome and roots.	Virginia Serpentaria.
23. Polygonaceæ.	Rheum officinale.	Rhizome.	Rhubarb.
	Rheum palmatum, and *var.* tanguticum.	Rhizome.	Rhubarb.
24. Chenopodiaceæ.	Chenopodium ambroisoidesanthelminticum.	Oil from fruit.	Oil of American wormseed.
	Beta vulgaris.	Refined sugar.	Sugar.[1]
25. Myristicaceæ.	Myristica fragrans.	Seeds.	Myristica.
26. Ranunculaceæ.	Aconitum Napellus.	Tuberous roots.	Aconite.
	Hydrastis canadensis.	Rhizome and roots.	Hydrastis.
	Delphinium Staphisagria.	Seeds	Staphisagria.
	Cimicifuga racemosa.	Rhizome and roots.	Cimicifuga.
27. Berberidaceæ.	Podophyllum peltatum.	Rhizome and roots.	Podophyllum.
28. Menispermaceæ.	Jateorhiza palmata.	Root.	Calumba.
29. Lauraceæ.	Cinnamomum Camphora.	Ketone.	Camphor.
	Cinnamomum—*sp. indetermined.*	Bark.	Saigon cinnamon.
	Cinnamomum zeylanicum.	Bark.	Ceylon cinnamon.
	Sassafras variifolium,	Oil of root.	Oil of Sassafras.
	Sassafras variifolium.	Bark of root.	Sassafras.
30. Papaveraceæ.	Papaver somniferum and *var.* album.	Exudation from capsules.	Opium.
	Sanguinaria canadensis.	Rhizome and roots.	Bloodroot.
31. Cruciferæ.	Sinapis alba.	Seeds.	White mustard.
	Brassica nigra.	Seeds.	Black mustard.
32. Hamamelidaceæ.	Liquidambar orientalis.	Balsam from wood and inner bark.	Storax.
	Hamamelis virginiana.	Distillation from bark and twigs.	Hamamelis water.
33. Rosaceæ.	Prunus serotina	Stem-bark.	Wild cherry.
	Prunus virginiana	Stem-bark	Wild cherry.
	Prunus Amygdalus, dulcis.	Seeds.	Sweet almond.
	Rosa gallica.	Petals.	Red rose.
	Rosa centifolia.	Distillation from flowers.	Rose water.
34. Leguminosæ.	Cassia acutifolia.	Leaflets.	Alexandria senna
	Cassia angustifolia.	Leaflets.	India senna.
	Copaiba, (*Sp. indeter.*).	Oléoresin.	Copaiba.
	Pterocarpus Marsupium.	Dried juice.	Kino.
	Ptercocarpus santalinus.	Heart-wood.	Red saunders.
	Toluifera Pereiræ	Balsam.	Balsam of Peru.
	Toluifera Balsamum.	Balsam.	Balsam of Tolu.
	Cytisus Scoparius.	Alkaloid.	Sparteine sulphate.
	Physostigma venenosum.	Seeds.	Physostigma.
	Vouacapoua Araroba.	Neutral principle deposited in wood.	Chrysarobin.
	Glycyrrhiza glabra typica.	Rhizome and roots.	Spanish licorice.
	Glycyrrhiza glabra glandulifera.	Rhizome and roots.	Russian licorice.
	Acacia Senegal.	Gummy exudation.	Acacia.
	Astragalus gummifer.	Gummy exudation.	Tragacanth.
35. Linaceæ.	Linum usitatissimum.	Seeds and oil.	Linseed.
36. Erythroxylaceæ.	Erythroxylon Coca.	Alkaloid.	Cocaine.
37. Zygophyllaceæ.	Guaiacum officinale.	Resin of wood.	Guaiac.
	Guaiacum sanctum.	Resin of wood.	Guaiac.
38. Rutaceæ.	Pilocarpus Jaborandi.	Leaflets.	Pernambuco Jaborandi.
	Pilocarpus microphyllus.	Leaflets.	Maranham Jaborandi.
	Barosma betulina.	Leaves.	Buchu.

[1] *See* Family No. 9, *Graminea*

Family	*Name of Plant*	*Part Used*	*Name of Drug*
	Barosma serratifolia.	Leaves.	Buchu.
	Xanthoxylum americanum.	Bark.	Northern prickly ash.
	Xanthoxylum Clava-Herculis.	Bark.	Southern prickly ash.
	Citrus Aurantium, amara.	Dried rind of fruit.	Bitter orange peel.
	Citrus Aurantium sinensis.	Outer rind of fruit.	Sweet orange peel.
	Citrus medica Limonum.	Outer rind of fruit.	Lemon peel.
39. Simarubaceæ.	Picrasma excelsa.	Wood.	Jamaica quassia.
	Quassia amara.	Wood.	Surinam quassia.
40. Burseraceæ.	Commiphora Myrrha.	Gum-resin.	Myrrh.
41. Polygalaceæ.	Polygala Senega.	Roots.	Senega.
42. Euphorbiaceæ.	Ricinus communis.	Oil from seeds.	Castor oil.
	Croton Tiglium.	Oil from seeds	Croton oil.
	Stillingia sylvatica.	Root.	Stillingia.
43. Sapindaceæ.	Paullinia Cupana.	Seeds.	Guarana.
44. Rhamnaceæ.	Rhamnus Frangula.	Bark.	Frangula.
	Rhamnus Purshiana.	Bark.	Cascara sagrada.
45. Malvaceæ.	Gossypium herbaceum.	Hairs of seed.	Purified cotton.
	Gossypium herbaceum.	Oil from seed.	Cotton seed oil.
	Althæa officinalis.	Root.	Marshmallow.
46. Sterculiaceæ.	Theobroma Cacao.	Oil from seed.	Oil of theobroma.
47. Ternstrœmiaceæ.	Thea sinensis.	Basic substance from leaves.	Caffeine.[1]
	Thea sinensis.	Organic base from leaves.	Theophylline.
48. Guttiferæ.	Garcinia Hanburii.	Gum-resin.	Gamboge.
49. Thymeleaceæ.	Daphne Mezereum.	Bark.	Mezereum.
50. Punicaceæ.	Punica Granatum.	Bark of stems and root.	Pomegranate.
51. Myrtaceæ.	Eucalyptus globulus.	Leaves and oil.	Eucalyptus.
	Eugenia aromatica.	Flower buds and oil.	Clove.
	Jambosa caryophyllus	Flower buds and oil.	Clove.
	Melaleuca Leucadendron.	Oil from leaves.	Oil of cajuput.
	Pimenta officinalis.	Oil from fruit.	Allspice.
52. Umbelliferæ.	Ferula fœtida.	Gum-resin from rhizome and roots.	Asafetida.
	Ferula Asafœtida.	Gum-resin from rhizome and roots.	Asafetida.
	Ferula Sumbul.	Rhizome and root.	Sumbul.
	Pimpinella Anisum.	Fruit and oil.	Anise.
	Coriandrum sativum.	Fruit and oil.	Coriander.
	Fœniculum vulgare.	Fruit and oil.	Fennel.
	Carum Carvi.	Fruit and oil.	Caraway.
	Petroselium sativum.	Fruit.	Parsley fruit.
53. Ericaceæ.	Gaultheria procumbens.	Oil from leaves.	Methyl salicylate
	Arctostaphylos Uva-ursi.	Leaves.	Uva ursi.
54. Styraceæ.	Styrax Benzoin.	Balsamic resin.	Benzoin.
55. Oleaceæ.	Olea europæa.	Oil from fruit.	Olive oil.
	Praxinus Ornus.	Exudation.	Manna.
56. Loganiaceæ.	Strychnos Nux-vomica.	Seed.	Nux vomica.
	Gelsemium sempervirens.	Rhizome and roots.	Gelsemium.
	Spigelia marilandica.	Rhizome and roots.	Spigelia.
57. Gentianaceæ.	Gentiana lutea.	Roots.	Gentian.
58. Apocynaceæ.	Strophanthus Kombé.	Seeds.	Strophanthus.
	Strophanthus hispidus.	Seeds.	Strophanthus.
	Aspidosperma Quebracho blanco.	Bark.	Aspidosperma.
59. Convolvulaceæ.	Exogonium Purga.	Tuberous root.	Jalap.
	Convolulus Scammonia	Dried root.	Scammony root.
60. Hydrophyllaceæ.	Eriodictyon californicum.	Leaves.	Eriodictyon.
61. Labiatæ.	Mentha piperata.	Leaves and flowering tops; oil.	Peppermint.
	Mentha piperita.	Secondary alcohol from oil.	Menthol.
	Mentha spicata.	Leaves and flowering tops.	Spearmint.

[1] *See* also Family No. 65, *Rubiaceæ*.

Family	*Name of Plant*	*Part Used*	*Name of Drug*
		tops; oil.	
	Thymus vulgaris.	Oil from flowering plant.	Oil of thyme.
	Thymus vulgaris.	Phenol from oil.	Thymol.
	Lavandula vera.	Oil from flowering tops.	Oil of lavender.
	Rosmarinus officinalis.	Oil from flowering tops.	Oil of rosemary.
62. Solanaceæ.	Atropa Belladonna.	Root.	Belladonna root.
	Atropa Belladonna.	Leaves and tops.	Belladonna leaves.
	Hyoscyamus niger.	Leaves and flowering tops.	Hyoscyamus.
	Datura Stramonium.	Leaves.	Stramonium.
	Capsicum frutescens.	Fruits.	Capsicum.
63. Scrophulariaceæ.	Digitalis purpurea.	Leaves.	Digitalis.
64. Pedaliaceæ.	Sesamum indicum.	Oil from seeds.	Sesame oil.
65. Rubiaceæ.	Cinchona Calisaya.	Bark.	Cinchona.
	Cinchona Ledgeriana.	Bark.	Cinchona.
	Cinchona succirubra.	Bark.	Red cinchona.
	Cephaëlis acuminata.	Root.	Carthagena ipecac.
	Cephaëlis Ipecacuanha.	Root.	Rio ipecac.
	Ourouparia Gambir.	Extract from leaves and twigs.	Gambir.
	Coffea arabica.	Basic substance from seeds.	Caffeine.[1]
66. Caprifoliaceæ.	Viburnum prunifolium.	Bark.	Black haw.
	Viburnum Lentago.	Bark.	Black haw.
67. Valerianaceæ.	Valeriana officinalis.	Rhizome and roots.	Valerian.
68. Cucurbitaceæ.	Citrullus Colocynthis.	Fruit.	Colocynth.
	Ecballium Elaterium.	Principle from fruit.	Elaterin.
	Cucurbita Pepo.	Seeds.	Pumpkin seed.
69. Lobeliaceæ.	Lobelia inflata.	Leaves and flowering tops.	Lobelia.
70. Compositæ.	Grindelia Camporum.	Leaves and flowering tops.	Grindelia.
	Grindelia cuneifolia.	Leaves and flowering tops.	Grindelia.
	Grindelia squarrosa.	Leaves and flowering tops.	Grindelia.
	Artemisia pauciflora.	Lactone.	Santonin.
	Anacyclus Pyrethrum.	Root.	Pyrethrum.
	Arnica montana.	Flower-heads.	Arnica.
	Matricaria Chamomilla.	Flower-heads.	Matricaria.
	Taraxacum officinale.	Rhizome and roots.	Dandelion.
	Lactuca virosa.	Milk-juice.	Lactucarium.

2. The Animal Drugs

Family	*Name of Animal*	*Part Used*	*Name of Drug*
1. Coccidæ.	Coccus cacti.	Dried female insect.	Cochineal.
2. Meloidæ.	Cantharis vesicatoria.	Dried beetles.	Cantharides.
3. Apidæ.	Apis mellifera.	Secretion in the honey-comb.	Honey.
	Apis mellifera.	Concrete substance from the honey-comb.	Yellow and white wax.
4. Gadidæ.	Gadus morrhua.	Oil from fresh livers.	Cod liver oil.
5. Physeteridæ.	Physeter macrocephalus.	Concrete fatty substance from head.	Spermaceti.
6. Suidæ.	Sus scrofa, *var.* domesticus.	Internal fat of abdomen.	Lard.
		Enzymes from glandular layer of fresh stomach.	Pepsin.
		Enzymes from fresh pancreas.	Pancreatin.[2]
7. Bovidæ.	Ovis aries.	Internal fat of abdomen.	Prepared suet.
		Purified fat of wool.	Hydrous wool fat.
		Thyroid gland.	Dried thyroids.
		Suprarenal gland.	Dried suprarenals.
	Bos Taurus.	Sugar from whey of cow's milk.	Sugar of milk.
		Fresh bile.	Oxgall.

[1] *See* also Family No. 47, *Ternstræmiaceæ.*
[2] *See* also Family No. 7, *Bovidæ.*

Family	*Name of Animal*	*Part Used*	*Name of Drug*
		From skin, ligaments and bones.	Gelatin.
		Organic acid from tallow.	Stearic acid.
		Pustules from animals vaccinated against cowpox.	Vaccine virus.
		Enzymes from fresh pancreas.	Pancreatin.[1]
		Pituitary body.	Desiccated hypophysis.
8. Moschidæ	Moschus moschiferus.	Dried secretion from preputial follicles.	Musk.
9. Equidæ.	Equus Caballus.	Serum from animal immunised against diphtheria.	Antidiphtheric serum.
		Serum from animal immunized against tetanus.	Antitetanic serum.

[1] *See* also Family No. 6, *Suidæ*.

PART II. PHARMACOLOGY AND THERAPEUTICS

DEFINITIONS

Pharmacology.—The study of Materia Medica and Therapeutics, including the origin, history, properties and uses of drugs and medicines. It includes:

Pharmacognosy.—The study of the physical and chemical characters of drugs, and the art of identifying and selecting them in accordance with those characters.

Pharmaco-dynamics.—The study of the action of remedial agents upon the organism of man or of the lower animals in a state of health.

Pharmacology.—This term, by general acceptance, is now limited to the study of the changes produced in living tissues by the administration of drugs.

Therapeutics.—The application of remedial agents in the treatment of disease. It includes:

General Therapeutics.—The application of curative agents other than drugs and medicines. *E.g.*, diet, climate, baths, venesection.

Rational Therapeutics.—Therapeutics based upon Pharmaco-dynamics. *E.g.*, the use of digitalis for mitral disease.

Empirical Therapeutics.—Therapeutics based upon clinical experiences only. *E.g.*, the use of colchicum for gout.

Therapeutics.—This term is often used as the name of the branch of study which deals with Therapeutics. Therapodynamics has been used in the same sense, but is faulty. Experimental Therapeutics has been suggested, but is not comprehensive.

With the exception of such incidental allusion to other agents as occasion may require, in this work will be considered only that part of Therapeutics which is concerned with the official drugs.

Toxicology.—The study of the nature, effects and detection of poisons, substances which, introduced into the body inopportunely or in excessive amounts, are capable of destroying life. Courses of study and treatises upon Toxicology are, for convenience, commonly made to include the subject of antidotes and treatment, although this is, strictly speaking, a part of Therapeutics.

MODES OF ADMINISTRATION OF DRUGS

(a) **Into the blood-vessels by transfusion.**—This method, while frequently employed in experimental research upon animals, is resorted to only under extraordinary circumstances in the human subject. Normal salt solution (*see* p. 64) is most commonly used after profuse hæmorrhage and in various forms of toxæmia. Among the objections to intra-venous injection are the difficulty of finding the collapsed veins and the danger, in puncturing a vein, of wounding the opposite wall of the vessel. Again, phlebitis, thrombosis or embolism may possibly be caused. As a rule, hypodermatoclysis (*see* below) is therefore preferable; but if the symptoms are very urgent, the tissues œdematous from dropsy, or the circulation too feeble to insure absorption, transfusion should be practised without hesitation. It is the most prompt method in instances of shock, and it has even been proposed, with a view to the prevention of shock, that the free use of intravascular hot saline infusion, injected while the patient is still under the anæsthetic, should be adopted as a matter of routine, after all severe operations, This, however, should not be practised before the operation, unless under exceptional circumstances, for the increased arterial tension would likely cause increased hæmorrhage during operative procedures. Intra-arterial, as well as intravenous, infusion is sometimes practised.

(b) **Into the subcutaneous tissues** (1) **by hypodermatic injection.**—A sterilized syringe, fitted with an aseptic hollow silver needle, should be used for the injection. A part of the body is selected (commonly the external surface of the fore-arm), where the skin is lax. The skin is raised between the thumb and forefinger of one hand, and with the other hand the needle is inserted under it for about an inch, care being taken to avoid muscles and veins. The syringe is slowly emptied, then withdrawn, and slight pressure is made for a moment over the puncture. The bulk of an injection, as a rule, should be about 0.30 mil (5 ♏). In order that abscesses may not result, the fluid should be aseptic, non-irritating, and free from solid particles. If not freshly prepared, it is advisable that a little boric acid should be added to it. The most convenient and satisfactory plan is to keep the drugs for hypodermatic use in the form of soluble tablets, and to dissolve one in the required quantity of water at the time the injection is called for. The advantage of this method is that it secures a much more rapid absorption than when the drug is given by the mouth, and it is ordinarily employed when the promptest possible effects are desired. (2) **By hypodermatoclysis.** By the bedside is placed an aseptic jar containing sterilized warm normal salt saline solution, to which air gains access only by means of a glass tube filled with sterilized cotton. From the lower part of this vessel extends a tube fitted to a trocar, which should be made

aseptic. The skin over the part chosen for the infusion (preferably the iliolumbar region—the space between the highest part of the crest of the ilium and the lower border of the ribs) having also been rendered aseptic, the trocar is thrust into the subcutaneous tissue, and the solution allowed to flow at a rate not exceeding 4 mils (1 fl. dr.) to each 500 gm. (1 lb.) of body weight in each fifteen minutes. The necessary pressure is obtained by the elevation of the container, and absorption of the fluid is aided by gentle massage. This procedure has been employed with advantage to replace the fluid lost from the body through hæmorrhage or through excessive purging, as in cholera; also to wash from the body various impurities circulating in the blood and lymph and to flush the kidneys. It has likewise proved of service in instances of surgical shock and of threatened death from anæsthetics. Hypodermatoclysis, however, is slower than other methods in shock, on account of the poor general circulation, and is also open to the objections that the introduction of a proper amount of fluid (1½ to 2 liters—3 to 4 pt.) may require a number of punctures, which subsequently, cause pain and that such a bulk of fluid causes tension of the tissues that, at the temperature best adapted to prevent shock (48.8°C.—120°F.), sloughing may possibly result.

(*c*) **Into serous cavities by injection.**—This method is employed only to secure certain local effects in such cavities themselves, as to wash out antiseptically the pleura after it has been opened or to cause adhesive inflammation in the tunica vaginalis by the injection of irritants. It has been proposed to introduce hot saline infusion directly into the abdominal cavity by means of a hollow needle for the purpose of combating shock. Also when this cavity is opened, as in cœliotomy, it may be flushed with hot saline infusion for the same purpose.

(*d*) **Into mucous cavities.**—The most common way of administering drugs is naturally by the mouth, so that they may be absorbed from the mucous membrane of the stomach or intestine. Circumstances conducive to rapidity of absorption are an empty stomach and a ready solubility of the drug in the gastrointestinal secretions. When it is intended that the drug shall act only in the intestine, pills, made purposely insoluble in the gastric fluids, are administered. It is probable that some drugs are excreted in the bile by the liver, and so never reach the general circulation. Care should be taken to prescribe drugs in so palatable a form as is possible and so combined as not to cause irritation.

It is sometimes advisable to administer drugs by the rectum, **suppositories** being employed for solids, and **enemata** or **clysters** for liquids. The fact must not be lost sight of that they are not then so readily dissolved or absorbed as when given by the mouth.

Enteroclysis is also employed in shock and allied conditions, and not infrequently in association with intravascular infusion. This consists of the irrigation of the intestine, commonly with a saline solution, and it is most satisfactorily practised by means of a double-current tube. With this tube the fluid does not cool, since fresh hot fluid is continually entering to replace the cooler which passes out. The method is of service in warding off shock, and has been resorted to for this purpose after surgical operations.

Drugs are also used for local effects, as by the **urethra** or **vagina** (**injections, bougies, pessaries**), or by the **respiratory passage** (**inhalations, cigarettes, sprays** or **nebulæ** for **inhalations**; **insufflations** for blowing into the nose, throat

and larynx; **pigmenta, gargarismata, trochisci,** for local effect on the mouth and pharynx; **nasal douches** for the nose). Sprays are given by means of an atomizer. Volatile drugs, as ether, chloroform and amyl nitrite, are usually inhaled for their general effect.

(*e*) **By the skin.**—Certain drugs may be absorbed from the skin if mixed with some fatty substance, especially hydrous wool-fat. In this way mercury may be absorbed by being rubbed in (**inunction**). Some may also be absorbed from the skin when they are volatilized. Thus mercury is introduced into the system by **fumigation.** The chief purpose, however, for which drugs are applied to the skin, is to secure their local effects, and for this they are employed in ointments, cerates, plasters, etc. To the **eye** and **ear** they are applied in washes.

POSOLOGY

The study of doses is called **Posology.** In determining the dose the following points deserve attention:

1. **Age.**—The adult dose is that for a person between twenty and sixty years old, but for women the dose should be somewhat smaller than for men.

For **children** under twelve, Cowling's rule—divide age at next birthday by twenty-four—is the simplest and is generally of sufficient exactness. It must be borne in mind, however, that in the use of certain drugs the dose may be relatively larger than for adults, while in that of others they must be relatively smaller. Thus, children bear iron, alcohol, arsenic, belladonna, hydrated chloral, rhubarb, and cod liver oil remarkably well, but can take only very small doses of opium and its preparations.

For persons above sixty the dose should be slightly diminished as the age advances.

2. **Weight.**—In pharmacological experiments upon animals, in which it is customary to express the dose as a proportion of the weight, it has been found that if the same amount of poison be distributed through the tissues of a large individual as of a small one, less is contained in any given organ of the former, and less effect is therefore observed. This no doubt holds true as regards man also; so that somewhat larger doses of drugs should be prescribed for very large persons than for those of ordinary stature, while in the case of persons of unusually small size the dose should be proportionately diminished.

3. **Habit.**—A person who takes a drug continuously usually becomes less and less susceptible to its influence. Thus, an opium *habitué* after a time finds it necessary to use enormous doses of the drug in order to secure the desired effect. With strychnine and some other similar drugs, however, the susceptibility increases, instead of diminishing, and among purgatives cascara sagrada appears to be an exception as regards habit.

4. **Idiosyncrasy.**—Many individual differences in the matter of susceptibility are met with. These idiosyncrasies, which have frequently been observed with almost all commonly used drugs, consist of extraordinary sensitiveness, or of tolerance, or of entirely atypical actions.

5. **Time of Administration.**—Drugs must be given with careful attention to the time which they require to produce their appropriate effects. Thus, some hypnotics have to be administered several hours before it is desired that the

patient should go to sleep for the night, while for others to act but little time is needed. In order to cause a morning evacuation of the bowels, slowly acting purgatives must be taken the evening before, but promptly acting ones before breakfast. Drugs which are readily decomposed by the contents of the stomach should be given when that viscus is empty, preferably a half hour before the meal time. Experience has shown that the body is generally more resistant in the morning than in the evening, especially in the case of narcotic drugs.

6. **Mode of Administration.**—Drugs being absorbed much more rapidly from the subcutaneous tissue than from the stomach and upper portion of the intestinal canal, smaller doses are required when they are administered hypodermatically than by the mouth. On the other hand, their absorption is slower from the rectum; therefore to produce the desired effect, the rectal dose must be larger. The tendency of modern therapeutics is towards smaller and more frequently repeated doses.

7. **Mental Influences.**—The mental condition of the patient sometimes has more or less influence on the effectiveness of drugs. Thus, if his mind is particularly fixed on the action of a hypnotic, so that he feels convinced that he will sleep, quite a small dose may answer the purpose, but if, on the contrary, he is laboring under considerable mental excitement and feels that it is quite impossible for him to sleep, an unusually large dose may be required.

8. **Other Temporary Conditions.**—Various other temporary conditions may influence the activity of drugs. As the drug is diluted by the stomach contents, absorption takes place more slowly after a meal than when the stomach is empty, and any local irritant action is less marked. Irritation of the stomach or intestine may also modify the effects of drugs, and vomiting and diarrhœa naturally tend to diminish their activity by quickly removing them from the alimentary canal. During pregnancy drugs must be used with great care. Purgatives may induce pelvic congestion, and thus lead to abortion, while drugs causing a marked fall of blood-pressure may have the result of asphyxiation of the fœtus. Drugs acting directly directly upon the uterus are naturally to be avoided, and also those whose effects may be transmitted from the mother to the child and injure the latter During lactation certain drugs are excreted in the milk, and these may either act upon the child or render the milk distasteful to it. At the time of menstruation all very active drugs must either be given with great caution or temporarily intermitted, and purgatives should generally be avoided.

9. **Temperature.**—The action of drugs often being in part chemical, the temperature may be a factor of some importance in determing their effects in the case of cold-blooded animals and excised structures, but as in man the temperature range is so limited, this element may be practically disregarded.

10. **Preparation of a Drug.**—As a rule, a smaller dose of a soluble preparation, as a tincture, will be required than of a solid preparation, as a pill, which may be only slowly dissolved before absorption can occur, although in the latter instance much depends upon the process of manufacture. Pills which have been manufactured for a long time may be entirely insoluble.

11. **Rate of Excretion.**—In order to produce a prompt effect, a smaller dose (other things being equal) will naturally be required of a drug that is excreted rapidly than of one the excretion of which is slow. It is also true that, in order to

maintain a continuous effect from drugs which are rapidly excreted, the doses must be repeated at shorter intervals.

12. **Cumulative Action.**—It sometimes occurs that in a person who has been taking a drug for some time, without the manifestation of any untoward effects, symptoms of poisoning suddenly make their appearance, or, at all events, that small doses of certain drugs taken repeatedly for a considerable period eventually give rise to symptoms which are more marked than those caused by a single dose. Such a result is attributed to the cumulative action of the drug, causing an acquired susceptibility, in consequence of which a given dose will produce more pronounced effects than it did originally. This is the opposite of habituation, and it may be due to any one of the following causes: (*a*) Greater capacity for absorption than excretion, as in the case of lead and mercury. (*b*) Inconstant absorption, successive doses of the drug being unabsorbed from the alimentary canal until such time as the conditions, in consequence of some alteration in the intestinal contents, may become favorable to absorption, when the whole amount is taken into the system at once. This is sometimes met with in the case of digitalis. (*c*) Summation of effects, the effect of the preceding dose not having disappeared when the succeeding dose is given. (*d*) Sudden arrest in the excretion of the drug. For instance, it is thought probable that from the use of digitalis the renal vessels become contracted when the quantity of the drug in the tissues has reached a certain amount, so that excretion can no longer take place. It has been suggested also that the organism is subject to what may be called an *education* to the effects of drugs, particularly in the use of certain ones acting upon the central nervous system. Under this hypothesis the fact that the susceptibility to strychnine increases with its administration would be explained by the central nervous system becoming educated to the stimulating actions and responding more readily to them. Cumulative action, it should be noted, may occur along with tolerance. Thus it is found that the tolerance of certain tissues for nicotine does not protect others from the effects of the abuse of tobacco.

13. **Disease.**—The action of drugs is liable to be greatly modified by disease. This is seen, for instance, in the use of antipyretics, which have little or no influence upon normal temperature, but have a pronounced effect in reducing pyrexia. The dose must sometimes be varied because of the conditions produced by disease. Thus, in peritonitis, and in many instances of hepatic, renal and other very severe forms of colic, enormous doses of opium may be borne perfectly well.

PHARMACOLOGICAL AND THERAPEUTIC ACTIONS

By the action of a drug is ordinarily meant its physiological action.

The primary action is that due to the unaltered drug. The emetic action of such drugs as zinc sulphate is an illustration of this.

The secondary action is that due to compounds formed from the drug in the body. Thus, genito-urinary disinfectants like cubeb and copaiba owe their effects in this regard to a combination with glycuronic acid, in which form they are excreted by the kidneys.

The local action is that produced at the point of application before the drug enters the circulation.

The direct action is that produced upon organs and tissues with which it comes into immediate contact.

The indirect or remote action is that produced as a secondary result. The paralysis of the heart caused by chloroform is a direct effect, while the fall of blood-pressure which results from this is an indirect effect of the drug.

The general or systemic action is the effect produced by the drug after absorption, and is due to its elective affinity for certain organs to which it is carried by the blood. Most active drugs have a selective affinity for special organs, as the heart or the central nervous system or certain definite tissues. Among those which select the central nervous system, for example, some act primarily upon the cerebral cortex, some upon the medulla oblongata, and some upon the spinal cord. It is sometimes the fact that a drug has the effect of affecting different structures in directly opposite ways. Atropine depresses the peripheral terminations of the secretory nerves, but stimulates the brain. Different drugs show very great differences in the extent of the field of their activity, and with most poisons the scope of this depends largely on the quantity administered. Hence, one which in small doses affects the medulla oblongata only, in larger doses may extend its influence to the brain and spinal cord, and when given in still larger amount act also on the heart and other organs. It is to be noted that the local effects of a drug may be entirely different in character from its general action; so that while it acts as an irritant at the point of application, it may be a depressant to the brain when it is carried thence in the circulation. For the reason that they are not absorbed or are absorbed in inactive forms, some drugs have only local action. Others, again, have only a local action because they are excreted or deposited with such rapidity that there is not a sufficient quantity in the blood at any one time to produce any general effects. Many powerful poisons on the other hand, show only a selective affinity for some internal organ to which they are conveyed in the circulation, and have little or no local action.

Relation between Chemical Constitution and Physiological Action.—While it is true that in a general way drugs closely resembling each other as to their chemical composition and properties produce similar effects upon the organism, as seen, for instance, in the use of the heavy metals, yet it is found that when their physiological action is carefully followed out, considerable differences in their effects are discovered. This is due to the circumstance that certain factors are met with which are apparently quite independent of their chemical constitution, or, at all events, which it is impossible to deduce from the latter. It is worthy of attention that the position of the radicals in the molecule is sometimes of great physiological importance. Thus, resorcinol (metadihydroxybenzene) has a very sweet taste, while pyrocatechin (orthodihydroxybenzene) is bitter. Moreover, substitution of one radical for another in organic compounds often greatly modifies the action. It can be stated then, that it may be inferred with some probability that any substance belonging to a chemical group of similar constitution will give rise to symptoms resembling in general character those of the other members of the group, provided that it does not contain some radical which renders it inactive or gives it a more powerful action in some other direction.

At the same time, the details of its action can be determined only by actual experiment. It is also equally true that the details of the chemical behavior of such substance can be ascertained only by performing the necessary reactions, and the point has therefore been well taken that for many drugs of definite chemical formula, while there is little prospect at the present time of explaining the latter from its constitution, there is still hope that much advance will be made in the near future in formulating the laws governing the details of its pharmacological effects.

The Theory of Ions has, for its fundamental or underlying basis, electrolytic dissociation. When acids, bases and salts, which, since they conduct the electric current, are termed electrolytes, are dissolved, either all or a part of the molecules are split up by the solvent into simpler substances, the electrically charged atoms or groups of atoms known as **ions**, constituent parts of the molecules which, under the directive influence of an electric current, travel in opposite directions through the solution. Those which take on a positive charge are called **kations**, and those assuming a negative charge, **anions**. A simple illustration is afforded in the instance of hydrochloric acid, a solution of which is made up not only of HCl molecules, but also of H ions and Cl ions. When such a solution is completely dissociated, it would be put down as H+ and Cl−. It is a fact, however, that while in a solution of hydrochloric acid there are dissociated chlorine ions, it does not contain free chlorine in the condition met with in a solution of chlorine gas. In solutions of a chloride the existence of chlorine cannot be demonstrated by its physical properties, but its presence can always be recognized by its reactions. The circumstance that all chlorides, by reason of their chlorine, yield a certain set of reactions which are precisely the same, whatever, the associated element may be, is regarded as proof of the correctness of the dissociation theory. Since all chlorides thus give off free chlorine-ions on solution, notwithstanding that each one in its solid condition is characterized by its own special properties, it becomes clear why they present a common set of reactions. The importance is insisted upon of the fact that only those portions of the substance which are ionized are chemically active, the ionized condition being necessary for the rapid reactions which electrolytes display. With the exception of hydrogen dioxide, water, the universal solvent of the body, seems to cause the best dissociation of molecules into ions. Formic acid comes next in this respect, then nitric acid; methyl alcohol is superior to ethyl alcohol, acetone and various ethereal salts follow, and hydrocarbons are of only feeble power. It has been found by experiment that only those substances which afford abnormal osmotic pressure in solution are capable of conducting the electric current, and if they are dissolved in other solvents in which they behave normally, they lose this power. The ions which conduct the current must always be present, *i.e.*, they are not formed by the current. The ions naturally act as molecules, and so increase the osmotic pressure. The ions which are formed from a substance must necessarily be charged with electricity; otherwise they would not conduct the current. Furthermore, some ions are always charged with positive electricity, while others are charged with negative; but no ion is known which is at one time positive and at another negative.

The physiological as well as the chemical effect of the electrolytes have been

found to be entirely dependent upon their constituent ions, quite irrespective of the nature of their molecules. Thus, all acids are characterized by H-ions, and it is in consequence of this that they all have certain general properties, while the differences between the solutions of different acids containing the same number of H-ions depend upon the difference between their anions. The kation of acids is hydrogen; the anion of bases is the hydroxyl group (OH). The general conclusion is, then, that the physiological effects of an electrolyte are for the most part determined by the character of its ions. While the principal characteristics of most of the substances which are of importance in therapeutics are farily well known, it is a desideratum to understand why or how it is that they produce their special effects, and, so far as the exectrolytes are concerned, the theory of ions would seem to largely supply such knowledge. For instance, the long-recognized community of the reactions of the dissolved salts of a given metal (being the same with respect to that metal whether the chloride, sulphate, nitrate, or other salt is employed), received no adequate explanation until the promulgation of this theory. In the solid state, and when undissociated in solution, each salt has individual attributes; while in dilute solution, when dissociation is usually more or less complete, the properties of the salt are merely the sum of the properties of its ions. If, therefore, a series of salts contains a common ion, the properties of this will be common to all its members. As an illustration of this the behavior of iron salts may be cited. While all the simple salts exhibit common chemical reactions and have a very similar physiological action, compounds such as the ferrocyanides, for instance, neither yield the reactions of iron or exhibit the influence of the metal in their physiological effects. The explanation would seem to be that the simple salts yield metallic ions on dissociation, but the ferrocyanides yield the group ferrocyanogen, neither the chemical behavior nor the physiological action of which is identical with that of iron itself. It is plain that when a dissociable body is administered, not one, but two separate agents are put in action in the tissues, so that the effect of each of the ions must be taken into consideration. In the great majority of such substances in the organic materia medica, however, the action of one ion is so much more powerful than the other that the less important one may be practically disregarded. This is especially true of the more toxic bodies. In the instance of morphine sulphate, for instance, while this exists in the body as a morphine and a sulphate-ion, the action of the former ion is so much more powerful than the other that the sulphate-ion is of no consequence. Evidence of this is furnished by the fact that morphine hydrochloride, which in the body is dissociated into morphine and chlorine-ions, has practically the same action as morphine sulphate. With less poisonous substances, however, both the ions may exert a more or less powerful influence. Thus, we find that quite different symptoms are produced by potassium sulphate and potassium bromide, and this is because here larger amounts can be administered, and the SO_4- and Br-ions are present in sufficient quantities to elicit their specific actions, which are quite as important as that of the K-ion. What are ordinarily called the strongest acids and the strongest bases are those which, in a given solution, are most ionized. The effects of an ion can be determined only by administering it along with another in the form of a salt, but certain ions, it has been pointed out, are so inactive in the tissues that, if any effect is noted after a com-

pound of which they form part, the action can be ascribed with certainty to the other ion, unless the change arises from alteration of the physical properties of the fluids. Thus, the sodium ion and the chloride ion have been ascertained to be both practically inert, except in so far as they change the osmotic pressure; hence if a sodium salt or a chloride be found to cause some change which is not due to the physical alteration, the action is to be attributed to the other ion of the molecule.

Many observations point to the conclusion that the irritability of muscle and nerve depend upon the presence in them of compounds of proteid with the various ions, sodium, potassium and calcium, in definite proportion. Furthermore, it has been demonstrated that the physiological effects of certain drugs can be modified in definite ways by the addition of chosen radicals to the molecule. Thus, the convulsive action of strychnine on the spinal cord is changed to a paralyzing effect by the introduction of methyl into the molecule. Again, the introduction of chlorine ions into certain fatty molecules increases their narcotic and toxic properties. The results of these investigations would seem to afford ground for the opinion that in the forces of ionic attraction and repulsion is to be found the explanation of the rouleau formation of red blood-corpuscles, the agglutination of bacteria in appropriate media, and the obscure facts of chemotaxis, illustrated by the attraction or repulsion which certain chemical media have for some bacteria and for leucocytes. Protoplasmic movements doubtless take place by means of ions, the electricity-bearing portions breaking down when in solution, and it has been suggested that toxic and antitoxic effects may be due to various alterations in the composition of protoplasm forming living tissue. If a toxin which depends for its activity on a large number of monovalent anions can be controlled by a small number of bivalent anions, or even ions of much higher valence (thus requiring a smaller quantity), the question of remedy is apparent. So, among antiseptics, salicylic acid may be destructive to low forms of life because it is easily dissociated in the tissue electrolytes and liberates large numbers of poisonous hydrogen kations. Mercuric bichloride and copper kations are for the same reason effective, but the solution of a mercury salt in strong alcohol (a substance in which no electrolytic dissociation occurs) has no germicidal properties. The neutralization of the toxic effects of phenol by concentrated alcohol is susceptible of a similar explanation. Under ordinary conditions, ions of high valence are markedly disinfectant; those of lower valence less so. As regards mercury salts, dissociation may be retarded by the introduction into and aqueous solution of either alcohol or of another salt dissociating the same anions. For example, calomel treated with increasing proportions of sodium chloride shows a steady decrease of toxicity, the cause of which is the progressive suppression of the formation of mercury ions. The dissociating power of a solvent is believed to be a function of all the physical or chemical properties of a substance, and not of any one of them. The results of experiment tend t demonstrate the chemical inertness of molecules. As the reactions proceed, and the ions already present are used up, it is found that the molecules are gradually dissociated and furnish new ions, which then enter into the reaction. The chemistry of atoms and molecules has thus given place to the chemistry of ions.

Osmotic Pressure is defined as the resistance offered by a non-permeating salt to the passage through a partially permeable membrane of the fluid in which it is dissolved; and this varies with the number of molecules and ions. For the occurrence of osmotic interchange the separating membrane must be permeable to water, but impermeable to substances dissolved in it; and the capillary wall, which separates the blood from the lymph, is not of this character, since through it there may take place both filtration due to difference of hydrostatic pressure and diffusion of substances in solution. The laws of osmosis may be thus summarized: (1) Solutions separated by any membrane permeable to water tend to have an identical molecular composition. (2) If the membrane is perfectly permeable to both solvent and dissolved substance the exchange of molecules will take place without change in pressure or volume. (3) If the membrane is less permeable to the dissolved substance than to the solvent, an increase of of liquid, or increase of tension, will occur in the stronger solution. (4) If a membrane is differently permeable to one dissolved substance than to another, equimolecular solutions of the less diffusible substance will be hyperisotonic (hypertonic) to the more diffusible. In the interchange of bodily fluids, however, the forces of filtration and diffusion complicate those of osmosis in the transference of material.

The *classification of drugs*, which is adopted here, is one in accordance with the parts on which they principally act.

DIVISION I.—DRUGS ACTING UPON ORGANISMS WHICH INFECT THE HUMAN BODY, OR UPON PROCESSES GOING ON OUTSIDE IT

A. Antiseptics are drugs which prevent the growth of micro-organisms, destroy or render innocuous the toxic products of their action upon the tissues of the body, or interfere with the absorption of such products. By some the use of the word antiseptic is limited to those substances which restrain the development of micro-organisms, while those which destroy the vitality of the latter are designated as germicides or disinfectants. The term disinfectant, by extension, is applied to those agents which kill non-pathogenic bacteria, as well as to those which destroy disease germs. Much discrepancy of statement is to be found regarding the fact of certain drugs being really antiseptics and as to the relative power of various antiseptics, owing to the circumstance that antiseptics act differently upon different organisms, while the difference between inhibiting the growth of micro-organisms and destroying their

vitality has been lost sight of. There are also certain factors determining the efficiency of an antiseptic which should be taken into consideration. Among these are the following: The nature of the antiseptic agent, the strength in which it is used, the temperature at which it acts, the nature and number of the micro-organisms, the nature and quantity of the associated material, and the time of exposure. In testing the value of any antiseptic it is requisite that all instruments and substances employed in the procedure should first be exposed to a temperature sufficient to destroy any adventitious bacteria. A cultivating medium, such as agar jelly, having been placed in two test-tubes, the substance to be tested, in suitable solution, is added to one of them; after which some fluid containing the micro-organisms selected is poured into both the tubes. Both are then closed with sterilized cotton to prevent the entrance of germs from the air, and observation from time to time will show how far the development of the micro-organisms has been interfered with by the supposed antiseptic. As the potency of an antiseptic is dependent upon so many circumstances, it is impossible to determine with exactness the relative efficiency of various agents. In the following list the most powerful and generally used antiseptics are placed first.

1. **Heat** is the best antiseptic, but there must be a temperature of at least 100°C. (212°F.). Infected clothing, bedding, etc., may be heated in a dry-air chamber to between 93.5° and 149°C. (200° and 300°F.), but, on account of its superior penetrating qualities, steam, driven, under pressure, through the articles is decidedly preferable. Instead of this, the infected material may be boiled in water. Surgical instruments are generally disinfected in this way, but 1 per cent. of washing soda (sodium carbonate) should be added to the water to prevent their rusting.

2. **Corrosive Mercuric Chloride** in a solution of 1 in 1000 is commonly used for disinfecting the hands and is sometimes employed in surgery and obstetrics. For most uses, however, one part to 3000 or 5000 of water, or even weaker, is the limit of safety. Gauze of the strength of 1 to 2000 will blister, if the skin is damp.

3. **Formaldehyde**, the official solution of which contains not less than 37 per cent., by weight, has extraordinary power as a surface disinfectant. It is especially useful for the disinfection of rooms and their contents when volatilized from a specially constructed lamp.

4. **Chlorine** for most purposes is too irritating, but the gas (which is generated by the action of hydrochloric acid on potassium chlorate or manganese dioxide) may be used to disinfect rooms. It is open to the objection that it attacks and bleaches many substances.

5. **Chlorinated Lime** is the best antiseptic for all excreta. 6. **Phenol, or Carbolic Acid**, is used but infrequently. If surgical instruments have been previ-

ously sterilized, the use of phenol indicates a distrust, on the part of the surgeon, of his assitants. 7. Various **Cresol** compounds are powerful antiseptics and employed to a large extent.

8. **Bromine,** and, 9, **Iodine,** are rarely used, because they are too irritating.

10. **Iodoform** is used for dusting upon wounds, sores, etc., but is objectionable on account of its extremely disagreeable odor. It should be previously sterilized.

11. **Quinine,** and, 12, **Salicylic Acid,** are too expensive for ordinary use.

13. **Boric acid** is used for many surgical purposes. Since in about a 2½ per cent. solution it inhibits the growth of most bacilli, it may be employed to preserve solutions intended for hypodermatic use.

14. **Zinc chloride,** and, 15, **Potassium Permanganate,** are much used for domestic purposes.

16. **Solution of Hydrogen Dioxide** is the principal ingredient of various popular disinfectants.

17. **Sulphurous Acid,** generated by the burning of sulphur, is used to disinfect rooms. It should always be associated with moisture. 18. **Charcoal** is not a disinfectant, but merely a deodorizer.

19. **Cresote, Zinc Sulphate, Ferric Oxide, Methylene Blue, Alcohol** and **Balsam of Tolu** are not much used.

Internal antisepsis has for many years been in dispute. The objection has often been raised that there are no known drugs which when swallowed or inhaled, with certainty will destroy micro-organisms, either in the gastro-intestinal tract or respiratory passages, unless they are sufficiently concentrated to injure or prove fatal to the patient. By some, however, it is claimed that calomel, betanaphthol and some other agents are capable of destroying certain varieties of micro-organisms in the stomach and intestines; and, whether this is true or not, it is undoubtedly a fact (and one that is often lost sight of) that an infinitely small amount of a remedy which could not be administered in sufficient amounts to destroy, will often completely inhibit the growth of micro-organisms. Such drugs should therefore be classed as internal antiseptics.

Antizymotics are agents which arrest fermentation, and are sometimes divided into two groups, antiseptics and disinfectants. The fermentative processes may be caused by organized ferments, such as bacteria and the yeast-plant, or by unorganized ferments (enzymes), such as pepsin, pancreatin, diastase, ptyalin, etc.

Deodorants, or deodorizers, are substances which destroy foul smells. The volatile deodorants are mainly oxidizing and deoxidizing substances which act chemically on the noxious effluvia, while the non-volatile deodorants are mainly absorbents, which condense and

decompose them. Many antiseptics and disinfectants are also deodorants.

B. Anthelmintics are agents which kill (vermicides) or expel (vermifuges) parasitic worms infesting the alimentary canal. Four kinds of these parasites are commonly met with:

(1) Tape-worm (*Tænia solium* and *Tænia mediocanellata*). Anthelmintics: **Aspidium** (mostly used), **Granatum, Pelletierine Tannate** (easily administered and very efficient), and **Pepo.**

(2) Round-worm (*Ascaris lumbricoides*). Anthelmintics: **Santonin, Oil of Chenopodium,** and **Spigelia.**

Anthelmintics for the tape- or round-worm should be given when the alimentary tract is empty, to ensure their coming into contact with the parasite, and a purgative should precede the anthelmintic by a few hours. If the latter is itself not also a cathartic, another dose of purgative medicine should be administered after it, to bring away the worm or worms. When aspidium is employed castor oil should always be avoided, as its use is attended with considerable danger. In the instance of tape-worm, in order to determine whether the head is discharged, each stool should be received into a separate vessel, then mixed with water, and filtered through coarse muslin.

(3) Thread-worm (*Oxyuris vermicularis*). Anthelmintics: Rectal injections of **salt water, infusion of quassia, calumba** or **nutgall, solutions of iron salts,** or **diluted oil of turpentine** are commonly recommended. Large soap and water enemata, the patient being in the knee-chest position, give the best results. Lime water is often very efficient. In the instance of children it is advised that the lower bowel should be first emptied by an injection of warm soap and water. The child should then be placed upon a bed with its buttocks elevated, and the tube of the syringe be passed gently within the inner sphincter. The fluid (soap and water, lime water, or salt and water), previously warmed, must be injected with some little force, so that it may be lodged in the upper part of the rectum; otherwise expulsive efforts will be immediately excited. It is best that the enema should be given at bedtime in order that it may be retained for a sufficient length of time.

(4) Hook-worm (*Anchylostomum duodenale* and *Uncinaria americana*). Anthelmintics: **Thymol,** 1 gm. (15 gr.), per day is taken. In severe instances this treatment may be preceded by a few doses of **Betanaphthol.**

C. Antiparasitics or parasiticides are substances which destroy parasites. The term is usually applied to those which are destructive to the animal and vegetable parasites found upon the cutaneous surface but of late has been extended to cover those found within the body as well.

(1) For the various forms of *tinea* the following are used: **Mercurial** preparations, especially the oleate, tincture of **iodine,** glycerite of **phenol,** an ointment of **pyrogallic acid,** a **boric acid** or **salicylic acid** lotion, **sulphurous acid, formaldehyde** and **thymol;** and if the patches are small, severe irritants, as **croton oil,**

cantharides, and **chrysarobin** ointment. *Tinea versicolor* never requires severe irritants.

(2) As parasiticides for *itch*, **sulphur** ointment, **balsam of Peru,** and **storax** are all effectual.

(3) **Pediculi vestimentorum** will be killed by any mild parasiticide. **Staphisagria**: 1 part of the fluidextract, 2 parts each, olive oil and lard, is often used.

(4) **Pediculi capitis** and **pediculi pubis** are also easily killed by mild parasiticides; **mercurials** or **staphisagria** are employed.

D. Antiperiodics are drugs which in diseases, which recur periodically, lessen the severity of the paroxysms or arrest their return. Some, and probably all, act as direct poisons to the micro-organism causing the disease.

They are **cinchona bark, quinine** and its salts (by far the most powerful), **quinidine, cinchonine, cinchonidine, arsenic trioxide, eucalyptus, hydrastis, salicin** and **salicylic acid.** They are used for all forms of malarial fever and neuralgia.

All doses of *official* drugs and preparations are to be understood as the "average approximate (but neither a minimum nor a maximum) dose for adults," and are given with each substance and its preparations which are employed for internal administration.

The Antiseptics

MERCURY

For the Preparations of Mercury and its Salts *see* p. 76.

Action of Mercury and its Salts

External.—Locally the metal itself and many of its salts are inert. The action of others varies from that of a mild stimulant to the effect of a powerful irritant and escharotic. Thus, the acid solution of mercuric nitrate is strongly caustic. Mercury and its salts are readily **absorbed by the skin,** so that all the physiological effects of the drug can be produced by inunction. When metallic mercury, rubbed into fine globules, is applied to the integument in ointment, it passes into the gland ducts and along the roots of the hairs, and, after being oxidized, is dissolved and taken up into the tissues. It is also possible for the vapor to be absorbed by the mucous membrane of the lungs, and this **pulmonary absorption** of the drug is not at all uncommon when volatilized mercurial preparations are applied to

the skin. Some of these preparations, when locally applied, have considerable efficiency in allaying itching, however produced, and a large number of them (among which may be mentioned the oleate, oxide, ammoniated and the corrosive chloride) are **anti-parasitic,** destroying the animal and vegetable parasites which infest the skin. Mercury is possessed of great **germicidal power.**

Lower Forms of Life.—Its germicidal potency is due to the fact that it is poisonous not only to higher, but also to lower, organisms. Whenever it comes into intimate contact with albumins, it forms an albuminate and destroys life, and therefore corrosive mercuric chloride and the other soluble salts of mercury are among the most important antiseptics at present known. It has been demonstrated that the bichloride in the strength of 1 to 50,000 destroys infusoria in about twenty minutes, and that even a solution of 1 part in 1,000,000 destroys algæ in the course of a few days. While the bacteria are somewhat more resistant than these, it is claimed that a solution of 1 to 1,000,000 will delay the development of some of them, and the anthrax bacillus, it has been found, fails to grow in blood which contains 1 part in 8000. At the same time, it is true that the germicidal power of the bichloride has been considerably over-estimated; for, while it has been commonly accepted that a strength of 1 to 1000 is sufficient to completely disinfect fluids within a few hours, it has been proved that anthrax spores, after having been exposed to the action of a 1 per cent. solution for many hours, are still capable of developing as soon as the antiseptic is removed. Calomel, it has been demonstrated, has some effect as an intestinal antiseptic; but, owing to the difficulty of bringing the insoluble salts into intimate contact with the microbes, they are naturally much less efficient as germicides than the soluble ones.

Internal.—Mercury, unlike other metals, has, as is shown by its powerful germicidal influence, a strong specific action on protoplasm, due to its marked affinity for nitrogenous molecules. While its different salts have different external actions, yet after absorption their effects on the system are as a rule much the same. Both the local and general effects of a soluble salt, such as the bichloride, are more pronounced than those of one like calomel (which is entirely insoluble in water) since it comes into more intimate contact with the tissues, and acts more energetically locally, and is absorbed more rapidly and in larger amount. When, however, mercury in the form of calomel

has been absorbed, the general effects are the same as if an equal amount had been taken up by the tissues as the bichloride. When mercury is absorbed, it circulates in the blood in the form of an albuminate, which is insoluble in water, but is rendered soluble by excess of proteid, and, also by such quantities of sodium chloride as are met with in the tissues. It has a marked **corrosive action,** which is the more powerful because the precipitate formed with proteids is less insoluble in the surrounding fluids of the body, and therefore affords less protection to the surface, than those formed by the other heavy metals; so that this destructive influence extends into the deeper cells.

Absorption and Elimination.—When mercury is administered regularly for a considerable time, elimination fails to keep pace with absorption. It disappears from the blood and is then deposited, in less soluble form, in the tissues and organs, and this accumulation is especially liable to occur in certain parts of the body, like the kidneys, the intestinal walls, the liver, the spinal cord, and the medullary cavities of long bones. Absorption of the drug may take place from all surfaces, and especially from serous ones. It is excreted principally by the bowels, but also to some extent in the urine, saliva, perspiration and milk. The excretion by the kidneys, which begins in about two hours, has been noted as long as six months after its use has been discontinued. Mercury has been found in serum and in pus from ulcers.

Alimentary Tract.—The first evidences of mercurialism are met with in the mouth. The initiatory symptoms are usually a slight fetor of the breath, which is later accompanied by a disagreeable metallic taste, and tenderness of the teeth when they are forcibly brought together. These are followed by stomatitis, sponginess of the gums, swelling of the tongue, and **profuse salivation.** That this condition is not due to any local action of the mercury is shown by the fact that it also may occur when the drug is administered by inunction or by subcutaneous injection. The salivation is apparently due to the direct effect of the agent on the secretory apparatus, and sometimes it is the first symptom to make its appearance. If the administration be continued, the quantity of saliva poured out becomes enormous; it is altered in character, contains mercury, and irritates the skin over which it flows. The fetor is excessive and the gums are intensely inflamed, being marked by a dark red line at their

junction with the teeth, and bleeding at the slightest touch. Both the parotid and submaxillary glands are enlarged and tender. The teeth become loosened in their sockets and may fall out, and excoriations caused by the irritation of the drug lead to the formation of ulcers, particularly where there are accumulations of microbes, as around carious teeth. Finally, the maxillary bones may undergo necrosis, as a result of the penetration of these ulcers, which sets up periostitis. Children under the age of three years are seldom salivated, but they are not exempt from the other untoward effects. In the stomach the action of the drug is less marked, but it may produce more or less hyperæmia, and in instances of poisoning this is accompanied by small hæmorrhages. In the small intestine also it has comparatively little effect, but in the cæcum and colon it gives rise to congestion and tumefaction of the mucous membrane, which later result in necrotic patches of considerable extent and ulcers about the folds; the appearances presented being practically identical with those met with in chronic dysentery. Perforation of the bowel may eventually occur. The intestinal inflammation is naturally accompanied by excessive purging and intense abdominal pain, with tenesmus. The stools, which are fluid in character and sometimes present a rice-water appearance, contain blood, mucus and shreds of mucous membrane. Small doses of the insoluble salts, however, usually cause loose passages without any griping or straining. They pass through the stomach undissolved, it is believed, but in the intestine, where time is afforded for the exercise of their affinity for epithelium, they become partially dissolved and produce the characteristic irritant effect of the drug. While a small proportion of such preparations is absorbed from the bowel, by far the greater part passes off unchanged in the fæces. It is possible, therefore, for very large doses of calomel to be taken without giving rise to any serious disturbance of the system. That salt, it has been found, exerts no action on the digestive ferments, but it has the effect of limiting the decomposition of food by retarding putrefaction in the intestine; its antiseptic action being aided by the removal of the decomposing mass in consequence of the increased peristalsis which it induces. After the use of calomel a diminution of the double sulphates in the urine is noted, due as much to its cathartic as to its antiseptic qualities. When calomel is administered it is likely that a small portion will be changed into the corrosive chloride, thus enhancing its antiseptic effects.

Further, it should be noted that the same transformation may take place after prolonged trituration with sugar of milk.

Liver.—At the present time there is no sufficient evidence, to show that, with the exception of the corrosive chloride, which increases the biliary secretion, the liver is directly affected by mercurials. It was formerly believed that calomel and some of the other mercurial purges increase the secretion of bile. This was suggested by the spinach-green color of the stools after the administration of calomel, but the latter is due to the circumstance that the bile is prevented by this drug from decomposition in the intestine. Mercury acts in the bowel even when the bile is suppressed, and the greenish color of the stools is due to bile pigment. Commonly this is decomposed by the microbes in the intestine, with the formation of the fæcal pigment, but mercury prevents, by its antiseptic properties, the growth of the microbes, and the bile therefore appears in the stools undecomposed and having its ordinary color. It is true that so-called "biliousness" is very frequently relieved by mercurials, but this is readily explained by the fact that the condition thus designated is one not dependent upon the liver, but a disorder of the alimentary tract. Where the good effects of mercury were supposed to be due to its power to increase the flow of bile, equally satisfactory results may be obtained by the use of other remedies not regarded as cholagogues. At the same time, it is true, as mentioned, that the corrosive chloride does actually have some effect in increasing the amount of bile, and it may possibly be the fact that occasionally when calomel is administered, some of it, owing to the presence of special conditions, is converted into that salt.

Kidneys.—Mercury in the form of calomel has but a comparatively feeble influence on the kidneys. When dropsy due to cardiac disease is present, however, it has been found that a moderate dose of calomel induces marked diuresis. In the accumulations of fluid resulting from cirrhosis of the liver and from renal disease its action in this respect is less constant, but may be sometimes pronounced. While the question has not been definitely determined, it seems probable that, since calomel and other salts of mercury are known to have an irritant effect upon the kidneys, the diuresis produced by them is due to their direct action upon the renal epithelium. Calomel probably produces its beneficial effects more from the catharsis which it excites than from its action on the kidneys. Mercuric chloride, on

the other hand, has an especially deleterious effect upon the epithelium of the convoluted tubes. When small amounts of mercury, especially of calomel, are taken, the excretion of the drug by the kidneys has not been found to cause any pathological changes in the organs, but if the administration is continued for a considerable length of time, it gives rise to interstitial and glomerular nephritis; while large amounts induce parenchymatous nephritis with glycosuria. The relative quantity of mercury excreted by the kidneys is said to be increased by the inflammatory changes occasioned. In acute mercurial poisoning, when death does not result in a few hours, anuria is frequently observed. While the whole kidney is congested and the glomeruli are acutely inflamed, the most distinctive feature met with is a necrosis of the epithelium of the tubules in portions of the cortex, and there may be observed even a diffuse nephritis; and anuria is the terminal result. As is the fact with certain other drugs, such as bismuth and aloin, there is sometimes a deposit of lime in the kidneys. When it occurs, the tubules are found to be filled with a deposit of calcium phosphate, which is occasionally mixed with some chalk. It is thought most probable that this is excreted in the necrosed cells and that, as these break up, it passes into the tubules. As a rule the more marked the intestinal disturbance, the less pronounced are the destructive changes in the kidney in instances of poisoning, and it has been found that the latter changes are most frequently caused by the corrosive chloride.

Nervous System.—Mercury has comparatively little effect on the central nervous system. In acute poisoning the only symptoms observed are secondary to the fall of blood-pressure, while consciousness is preserved to the last. In chronic poisoning, however, there are not infrequently noticed tremor, erythism and hallucinations, which appear to be of central origin. Sometimes there is a dulling of the faculties. The general muscular weakness observed is believed to be due, not to any affection of the peripheral muscles and nerves, but to alterations in the centers. The paralysis which is sometimes seen in the limbs of workers in mercury has, on the other hand, been attributed to the action of the drug on the peripheral nerves, destroying the myeline sheath, and the areas of partial anæsthesia and the pains in the joints are also probably due to peripheral changes. The muscles do not appear to be directly acted upon in either acute or chronic poisoning. Even when paralysis is developed, they maintain

their irritability and do not undergo atrophy. In some instances, especially when the tremor is pronounced, the reflex excitability of the spinal cord is found to be exaggerated, but as a rule it remains unaffected.

Circulation and Respiration.—In some instances of acute poisoning areas of fatty degeneration have been found in the heart. For the most part, mercury has but little direct action on the circulation, and such changes as occur in the pulse are attributable to the collapse in acute, and to the cachexia in chronic, poisoning. When general poisoning is caused by the intravenous injection of the drug, however, it is found that there occurs a very marked **fall of blood-pressure,** which is due to a direct paralyzing action on the heart (involving both ganglia and muscle) and on the blood-vessels. The marked breathlessness which is sometimes observed in instances of chronic poisoning has been ascribed to the general muscular weakness.

The Blood and Nutrition.—In health the red corpuscles and the hæmoglobin appear to be at first augmented and afterward diminished, and while the number of newly formed leucocytes has been found to be increased, this is more than counterbalanced by the diminution of the older cells. In syphilis it has been noted that a pronounced decline in the amount of hæmoglobin is followed by an increase to beyond that present before the treatment was commenced, while there have been found fewer newly formed leucocytes, and more mature ones, after mercury. It would appear, therefore, that the blood reaction is different in health from that in syphilis, and that it varies in the successive stages of that disease. Whether mercury affects the nutrition in any way except through its action on the alimentary canal is not definitely known. It has been stated by some that the urea is increased by the use of small doses, but the investigation of these metabolic effects is very inconclusive, on account of the extensive action of mercury on the kidneys and intestine, and the prolonged administration of the drug is necessarily restricted to syphilitics. Very small doses may perhaps act in much the same manner, and have the same beneficial effect upon metabolism, as small doses of arsenic. Chronic mercurial poisoning affects metabolism profoundly, producing marked cachexia.

The Skin.—The excretion of mercury through the skin may produce various **cutaneous affections.** The most common eruption is a polymorphous erythema, more or less resembling that of scarlet

fever. In other patients it is erysipelatous in character, with subcutaneous œdematous swelling, and still other forms are urticaria, roseola, pemphigus and purpura. Sometimes there is produced a very severe eczema, which eventually becomes pustular, and this is said to occur most frequently as the result of inunction. Usually the eruption is evanescent, being followed by desquamation in two or three days; but there has been observed a severe generalized dermatitis, with marked swelling of the face and extremities, excessive desquamation, subcutaneous infiltration, excoriation, fever, disturbance of the respiration, and prostration, resulting even in death.

Temperature.—Mercury in itself has no effect on the body temperature, but in severe ptyalism and in the more serious cutaneous affections caused by it there is always more or less febrile reaction. In collapse resulting from poisoning by the drug the temperature may fall several degrees below the normal.

Therapeutics of Mercury and its Salts

External. *Antiseptic Action.*—Mercurials, and especially the bichloride, are used very extensively for **antiseptic** purposes in surgery and midwifery. For disinfecting the hands, the following method is trustworthy: (1) The hands and nails are thoroughly cleansed with hot water and soap, the water to be as hot as can be borne, and the brush used to have been first sterilized with steam. This preliminary brushing should occupy from three to five minutes. (2) The hands are rinsed in clean, warm water. (3) They are next immersed for one or two minutes in a warm, saturated solution of potassium permanganate, and while in this solution they are thoroughly rubbed with a sterilized swab of absorbent cotton. (4) They are next placed in a warm, saturated solution of oxalic acid, and kept there until completely decolorized. (5) They are then thoroughly washed in clean, sterilized water or salt solution. (6) Finally, they are immersed for two minutes in 1 to 500 corrosive sublimate solution, rinsed in water, and dried. On account of the difficulty of thoroughly disinfecting the hands, cotton or rubber gloves may be worn by surgeons and obstetricians when operating. For washing the walls or floors of infected rooms and furniture, linen and other articles, and for saturating towels, lint, sponges, etc., used in operations, a corrosive sublimate solution of the strength of 1 to 1000 is usually employed.

The corrosive chloride cannot be used for disinfecting metallic instruments, as mercury becomes deposited upon them. The use of this salt is believed to have been one of the principal factors in the remarkable reduction of the death-rate which has recently been noted in lying-in hospitals.

In preparing a surface of the body for operation the part is generally scrubbed with soft soap and warm water, and, after being shaved, is cleansed with ether or alcohol. It is then irrigated with a 1 to 1000 bichloride solution, but if the skin is at all broken a very much weaker one is employed. For a single washing of wounds or cavities the strength should not exceed 1 to 2000, and weaker solutions are preferable. For continued irrigation it should not exceed 1 to 10,000, and even this strength has been known, when used in the peritoneal cavity, to give rise to toxic symptoms. Gauze moistened in a weak bichloride solution is frequently used as a dressing after operations. The addition of sodium or ammonium chloride will increase the rapidity of solution of the bichloride in water but the use of these chlorides will delay the dissociation of the bichloride into ions and so markedly reduce the antiseptic value of the solution. In using the bichloride and other preparations of mercury as antiseptics it is often advisable to use these chlorides or to add about 5 parts of tartaric, citric or hydrochloric acid to 1 of the mercurial in the solution employed, in order to prevent its uniting with the albumin of the tissues. Otherwise an insoluble mercury albuminate may be formed, and the antiseptic value of the fluid be destroyed. Harrington's solution is excellent. Mercuric chloride, 0.8; hydrochloric acid, 60; distilled water, 300; alcohol, 640. Bichloride solutions should as a rule be freshly prepared, but if it is necessary for any reason to keep them for some length of time, either sodium chloride or a weak acid should be added to prevent decomposition of the bichloride. The incompatibles of the bichloride, such as alkaloids, alkalies, lime water, and soap should always be borne in mind. A small amount of soap, adhering to the hands, will markedly diminish the antiseptic value of a solution of mercuric chloride, if they are dipped in it. In making solutions of the bichloride it is always well to use distilled water because silicates, carbonates and sulphates and other substances, which may be found in ordinary water decompose the mercury salt. Bichloride tablets, with sodium indigotindisulphonate which colors them dark blue, for safety against their accidental ingestion, and

which are made of such strength that one dissolved in a pint of water makes a solution of 1 to 500, are convenient. Mercuric biniodide (1 to 4000 or 20,000) has been used to some extent as an antiseptic, and in eye surgery is said to be preferred by some to the bichloride, on account of its being less irritating than the latter.

Irritant Action.—The acid solution of mercuric nitrate is of service in the treatment of warts, chancroids, syphilitic condylomata, mucous patches, and ulcers of the mouth, while citrine ointment, properly diluted, may often be applied with advantage to ulcers and sores, whether syphiltic or not, when a stimulating effect is desired. The application of the solution of the nitrate is painful and may cause hæmorrhage and sloughing. It should never be employed for venereal ulcers in full strength, and as a substitute Ricord's method of treatment may be adopted. This consists of washing the sores or condylomata with solution of chlorinated soda, and, after drying with absorbent cotton, dusting calomel, or equal parts of calomel and starch, over the surface. When a milder preparation is required, black wash (Calomel, 1; glycerin, 8; mucilage of tragacanth, 20; lime water, to 160); is very commonly used.

Antiparasitic Action.—Mercurial preparations are among the most valuable applications in external **parasitic** affections. For destroying lice upon the head, or elsewhere, white precipitate ointment, dilute citrine ointment, and corrosive sublimate, in the form of a wash, are all used, and the same agents, particularly the latter, are also efficient in such conditions as scabies, favus, ringworm, tinea, and pityriasis versicolor. The oleate of mercury is employed to some extent for the same purposes, but it should be diluted with oleic acid with the addition of one-eighth part of ether, for most patients. Caution should be exercised in not applying mercurials over too large an area, on account of the risk of toxic effects through absorption.

Cutaneous Affections.—A weak calomel ointment is often of service in itching affections, especially around the anus. In impetigo contagiosa and ecthyma, an ointment containing 10 per cent. of calomel may be applied after separation of the crusts. Calomel ointment, as well as white precipitate ointment with the addition of a little menthol and cocaine, are also beneficial in herpes, herpes zoster, seborrhœa and eczema, especially of the genital organs. An ointment which is highly esteemed in many skin diseases is composed of equal parts of diluted mercuric nitrate, zinc oxide, and lead acetate

ointments. For chronic psoriasis and eczema, especially of the hands and feet, an ointment composed of equal parts of mercuric nitrate ointment and hydrous wool fat, with a varying amount of oil of juniper, has been found efficient. Black wash and yellow wash (Corrosive mercuric chloride, 1; lime water, 240) may also be used to allay the itching of such cutaneous affections as pruritus senilis and urticaria, if the disease is not too extensive in area. After the affected parts have been bathed with this they are covered with oiled silk or other impermeable material, and then enveloped with a light dressing and bandaged.

Diseases of the Eye and Ear.—In ophthalmic practice the ointment of yellow mercuric oxide, known as Pagenstecher's ointment, diluted if necessary, is largely employed particularly for conjunctivitis, keratitis and blepharitis. Calomel is also used as a sedative application in conjunctivitis and other affections. Before applying calomel to the eye, however, it should first be ascertained whether the patient has had a course of iodine treatment, since, if this is the fact, a caustic compound may be formed between the mercury and iodine which may set up violent inflammation of the conjunctiva and the lids, possibly resulting in loss of vision. Largely diluted citrine ointment is sometimes used in the place of Pagenstecher's ointment in the treatment of chronic blepharitis, tinea tarsi, and eczema. Favorable results have been reported from the subconjunctival injection of 0.12 mil (2 ♏) of 1 to 1000 solution of mercury bichloride in iritis (both syphilitic and non-syphilitic), exudative choroiditis, central choroido-retinitis, and detachment of the retina. In ear affections a 2 per cent. ointment of yellow mercuric oxide in cold cream, is used to subdue inflammatory action.

Absorbent Action.—Oleate of mercury and the various mercurial ointments are used to reduce swellings and promote the absorption of subcutaneous effusions and the products of inflammatory action. They are not, however, superior in efficiency to other agents for such purposes, and may have the disadvantage of introducing mercury into the system. While in some instances the constitutional effects of the latter may not be contra-indicated, in many others they may prove decidedly objectionable and even dangerous. The likelihood of the occurrence of such absorption and its possible consequences should always be borne in mind. Mercurial ointment, blue ointment, or Scott's ointment (Mercurial ointment, 10; yellow wax, 6;

olive oil, 6; and camphor, 3), may be applied in affections of the joints, for orchitis and chronically enlarged glands. Chronic peritonitis has sometimes been treated with success by the use of a binder spread with one of these preparations or with a liniment composed of equal parts of mercurial ointment, solution of ammonia, and camphor liniment.

Internal. *Alimentary Canal.*—One of the most important internal uses of mercury is as a **purge,** and the two preparations employed for this purpose are blue mass and calomel. In the condition commonly known as biliousness, which is characterized by lassitude, headache, constipation, nausea, yellowish-coated tongue, yellow conjunctivæ, and more or less "muddiness" of the skin, either of these drugs at night, followed by a saline in the morning, will often completely relieve the symptoms, which are due, not to hepatic derangement, but to disorders resulting from the putrefactive changes in the gastro-intestinal tract. The principal action of the mercurials, it is believed, is exercised partly upon the glandular system of the gastro-intestinal tract, and partly upon the bacteria of the tract, which, after being destroyed by the antiseptic properties of the mercurial, are swept away by the succeeding purge. Blue mass is less certain and less energetic in its action than calomel. In conditions where there are loss of appetite, tympanites, jaundice and whitish or clay-colored stools, and which are due to a catarrhal state of the mucous membrane of the hepatic duct and of the intestine, mercurials have long been highly esteemed on account of their supposed cholagogue action. It is true that they are generally efficient in removing the symptoms, but it is in the manner just referred to, and it has been found that such salines as sodium phosphate, magnesium sulphate and Rochelle salt will often succeed equally well. In conditions like the above and in others where there is constipation, instead of giving a single full dose of blue pill or calomel, the practice has now become quite commonly adopted of prescribing the latter in small doses, such as 0.015 to 0.006 gm. (¼ to 1/10 gr.), thoroughly triturated with sugar of milk and repeated every hour until a movement is secured. Some omit the calomel after four or five doses have been taken, and give a dose of bitter water or Rochelle salt the next morning. The efficiency of the calomel may be increased by combining with each dose, 0.13 gm. (2 gr.) of sodium bicarbonate. Repeated small doses of calomel have been found to be entirely satisfactory and much

more comfortable for the patient than the use of large doses. Mercurials are usually well borne by infants and children. Gray powder (Mercury with chalk), in minute doses, has been advised for the sudden vomiting which occurs immediately after the ingestion of food and is sometimes observed in children. In diarrhœa due to the presence of some irritant in the intestinal tract, one or two doses will not infrequently prove curative by removing the offending material. Gray powder is a very useful purgative for children, and also for adults when a very mild effect is desired. Its action does not, as a rule, cause any griping, which is sometimes quite marked in the case of calomel. On account of their antiseptic effect in the intestine, mercurials are given to a considerable extent in typhoid fever. Some physicians make it a practice to commence the treatment of this disease with calomel.

Cardiac and Inflammatory Diseases.—In valvular disease of the heart with dropsy, mercury sometimes proves of great service when combined with digitalis and squill, as in Guy's diuretic pill, which is composed as follows: Blue mass, powdered squill, and powdered digitalis, each, 0.06 gm. (1 gr.); extract of hyoscyamus, 0.03 gm. (½ gr.). The drug is considered by many a very valuable antiphlogistic agent, provided that its use be restricted to the treatment of inflammatory action of a sthenic type. Some authorities believe it to be the best remedy in sthenic endocarditis, and useful also in myocarditis and pericarditis. While mercury bichloride is sometimes used instead of calomel in these affections, for the reason that it does not produce catharsis, it has not usually been found as efficacious as calomel. When the latter is given as a so-called antiphlogistic, opium is commonly combined with it, not only to prevent its acting on the bowels, but also to relieve pain and irritation. In meningitis resulting from cerebral injuries it has been recommended that a powder containing 0.015 gm. (¼ gr.) each of calomel and powdered opium should be given every hour for five or six hours, while at the same time an ice-bag is kept applied to the head. In the early stages of diphtheria and croup, mercury is thought to exert distinct prophylactic power. It is generally given in the form of the bichloride, but some advocate, as preferable, the use of calomel, administered in small repeated doses as a dry powder, believing that the good effect of the mercurial is at least, in part, due to its diffusion over the diseased surface, and the consequent antiseptic influence thus produced.

In both pneumonia and pleurisy large doses of calomel have been highly recommended by certain clinicians, but the weight of opinion is to the effect that mercury is of decidedly less value in parenchymatous inflammations, such as pneumonia and hepatitis, than in those of a serous character, like pleurisy, pericarditis and peritonitis. It should be carefully borne in mind that it ought never to be given in asthenic inflammatory conditions, and that in employing it as an antiphlogistic it should be exhibited during the stage of exudation, and to facilitate the absorption of the newly organized lymph. In the treatment of iritis the use of mercury has proved especially successful, and it is the common practice in this affection to push the remedy to the point of ptyalism whenever the tendency toward the exudation of lymph is marked. Although the matter has never as yet been practically demonstrated, there is considerable ground for the belief that the drug has the effect of diminishing the fibrin in the blood, and as in inflammatory conditions the latter is known to be increased, it has been supposed that there is a certain antagonism between the processes of mercurialization and of inflammation. On the other hand, many authorities believe that mercury has little or no remedial influence in acute inflammation, either in the serous membranes or elsewhere, and that as it is commonly combined with opium, whatever benefit is noted from such treatment in inflammatory affections is to be attributed to that drug. In iritis, in which the efficacy of mercurials is admitted by all, it is contended that the good result is due to the fact that this disease is almost universally of syphilitic origin. At present, the antiphlogistic use of mercury has undoubtedly become much more restricted. The various forms of the drug are now very commonly administered in the shape of triturates, made with sugar of milk, which contain about 10 per cent. of the mercurial preparation. Thus minutely subdivided, the remedy is found to be more readily absorbed.

Syphilis.—Undoubtedly the most important of all the uses of mercury is in the treatment of **syphilis**, even if we carefully value the results of administration of those preparations of arsenic which permit of massive dosage. While the results of massive doses of arsenic in the early stages of syphilis often seem, and really are, remarkable, the certainty and permanence of cure still requires the administration of mercury and, later, of the iodides. Like quinine in malarial fever, it is universally conceded to be a specific, although its

precise mode of action has not as yet been determined. While some have contended that its curative influence is due simply to the general effects upon metabolism, it seems altogether probable that this is attributable to a specific toxicity for the syphilitic germ, which, when the drug is adequately exhibited, finally results in the complete destruction of the latter. Some syphilographers hold that the action of mercury is to clear away from the tissues the products of a specific inflammation, or at least to relieve tissues encumbered with superfluous and obstructive material; but whether it develops a specific destructive action on the germ or not, the fact remains that mercury is employed in syphilis because experience has shown indisputably that it cures the disease. In order to secure the most satisfactory results it is requisite that its administration should be commenced at the earliest possible moment and that it should be continued for a considerable period after all manifestations of the disorder have disappeared. Its value in syphilitic condylomata, ulcerations, etc., has already been referred to, but here its local application is not sufficient, and an internal mercurial course should be entered upon just as soon as the diagnosis is established. This should never be discontinued under one year, and it is not infrequently necessary to maintain it, with periods of intermission, for several years. While all are agreed as to the efficacy of the drug in the first and second stages of syphilis, authorities differ as to its value in the third stage. As a rule, however, in the tertiary period it will be found that the best results can be obtained by mixed treatment, as it is called, mercurials in combination with the iodides, particularly potassium iodide. In most instances in which the disease is recognized early and in which mercurial treatment is promptly instituted and faithfully carried out, no tertiary symptoms occur and the use of the iodides is entirely uncalled for. The dose of the remedy should be carefully regulated in accordance with the circumstances of each individual patient. The effort should be made, it is recommended, to give the largest amount that can be borne without the production of gastric, buccal, or other irritation; in other words, to overwhelm the disease without detriment to the general condition of the patient. In the earlier stages the proto-salts of mercury (and particularly mercurous, known as the yellow, iodide) are considered the most serviceable; later in the disease, especially when used in conjunction with potassium iodide, it is customary to employ the per-salts, the

bichloride and biniodide being the most esteemed. By some the deep intramuscular injection of mercurials is recommended. For this purpose the insoluble salts as calomel or mercuric salicylate, in suspension, may be employed. Under special circumstances these agents are introduced into the system in various other ways, than by the mouth, for instance by inunction, 2 gm. (30 gr.) of mercurial ointment, or the oleate, well rubbed into the inner surfaces of the thighs or upper arm or into the chest or abdomen, sometimes into the back, on alternate days. Mercury is as efficient in congenital syphilis as in the acquired form.

Modes of administration of mercurials.—(1) **By the mouth.**—Many of the preparations of mercury most commonly used for internal administration have already been spoken of. Corrosive mercuric chloride, 1; ammonium chloride, 1; water, 1000; is a favorite preparation, and is frequently combined with potassium iodide in tertiary syphilis. The usual dose is 8 mils (2 fl. dr.). When used with potassium iodide, there is formed mercuric iodide, which is kept in solution by the excess of the potassium iodide. Mercurous iodide should never be given at the same time as potassium iodide, as the latter immediately converts it into red mercuric iodide and metallic mercury. Gray powder, as has been mentioned, is much used in the intestinal disorders of children. It is also the most generally satisfactory preparation for internal administration in syphilis of early life. The ordinary dose is 0.06 gm. (1 gr.), which should be given frequently enough to bring the system under the influence of the drug without affecting the bowels. By some authorities it is considered the best preparation for continued used in syphilitic adults, as well as children. For syphilitic ulcerations of the mouth a very good lotion may be made of corrosive mercuric chloride, 0.24 gm. (4 gr.), in 300 mils (10 fl. oz.) of water to which is added, 4 mils (1 fl. dr.) of diluted hydrochloric acid and a little glycerin. In syphilitic ulceration of the tongue, troches of licorice, each containing 0.003 gm. ($\frac{1}{20}$ gr.) of the bichloride, are sometimes employed. Allowed to dissolve in the mouth, they produce a constitutional as well as a local effect. Mercurials are not well borne by patients suffering from Bright's disease, in whom ptyalism is more readily induced than in others, nor by gouty or scrofulous subjects. In the latter, mercurialization may give rise to very serious results, and where there is a gouty tendency, neuralgia, is often caused by small doses.

(2) **By the rectum.**—By the use of suppositories patients can be brought very rapidly under the influence of the drug, and occasionally this method will be found of service. Each suppository may contain 0.30 gm. (5 gr.) of mercurial ointment.

(3) **Endermatically.**—Mercurials, externally applied, produce a general, as well as a local, effect, on account of their ready absorption. Reference has already been made to the use of various lotions in ulcers and syphilitic condylomata, and the preparations in powder form, particularly calomel, are often dusted on the surface in these conditions.

(4) **By inunction.**—Mercury applied by inunction is quickly absorbed, and this method has a well-recognized position in the treatment of syphilis. Among the other conditions in which it has been found of service is gonorrhœal arthritis. It is used to a considerable extent in the treatment of infants and young children afflicted with congenital or acquired syphilis, and also for adults when it is desired to bring the system rapidly under the influence of the drug, and at the same time to avoid disturbance of the digestive apparatus. Either mercurial ointment or the oleate of mercury may be used for this purpose, and the latter possesses the advantage of not staining the clothing. It is customary to rub a piece about the size of a marble upon the inner side of the thigh or arm once or twice a day, and it is advised to change the application from place to place on account of the local irritation sometimes caused by the mercury. A hot bath previous to each inunction assists absorption. If the patient does not apply the mercurial himself, it is advisable that the person doing so, in order to avoid accidental salivation, should be protected by a rubber or other glove, and should also wash his hands thoroughly with soap after each application. Another plan is to rub the ointment on the soles of the feet, so that the exercise of walking may promote absorption of the remedy. In the treatment of children it is often spread upon the abdomen, after which the latter is covered with a flannel binder. At present it is not regarded as necessary that mercurials should be rubbed into the skin with friction, as it has been found that the mere fact of spreading them upon the surface of the body and leaving them in contact with the skin is sufficient to secure the physiological effects of the drug. Another method of external application is to paint the patient's back, after bathing, with a solution of rubber in chloroform, to which has been added a quarter of its weight of calomel. After the chloroform has evaporated the skin remains coated with a mercurial varnish. Calomel soap, made by triturating pure olive oil soap with calomel in the proportion of one to two or three, has been used by some as a substitute for mercurial ointment. It is cleanly and non-irritating to the skin, and its use is said to constitute an efficient method of mercurialization. A rare complication which has been attributed to the effect of mercury on the system is multiple neuritis, and it is believed that this has especially been noted after the very free use of mercurial inunctions.

(5) **Hypodermatically.**—This method is now practised to a considerable extent in special instances, and is a cleanly, rapid and efficient way of producing the constitutional effects of mercury without gastro-intestinal irritation. It is said to be more successful than any other in preventing relapses in syphilis. The corrosive chloride is usually selected for this purpose, and if properly employed seldom produces local irritation, although instances have been recorded in which it gave rise to abscesses and sloughing. Care should be taken that the syringe and needle are aseptic, and it is recommended that the needle should be deeply inserted, preferably into the muscles on the outer side of the gluteal region. The solution must not be injected directly into a vein. If much pain is caused by the injection, ice may be held over the spot both before and after the insertion of the needle, or cocaine may be injected immediately before the mercurial. But one injection a day should be given, and it is advised that this should be at bedtime. A solution of 0.06 gm. (1 gr.) of corrosive chloride in 8 mils (2 fl. dr.) of distilled water

may be employed, and of this 0.60 mil (10 ♏) may be administered at first, and the dose gradually increased until 3 mils (50 ♏) is reached, or until constitutional effects are observed. As soon as this occurs the dose should be reduced to the minimum. In emaciated and cachectic syphilitics, it is recommended, instead of using daily injections in small doses, to give as much as 0.015 to 0.02 gm. (¼ to ⅓ gr.) two or three times a week. A large number of mercurial preparations have been proposed for subcutaneous injection, but none of them has any distinct advantage over corrosive sublimate; while some of them have been found considerably more dangerous. Mercuric salicylate, which is insoluble in water may be administered in 10 to 20 per cent. mixture with liquid petrolatum to which 0.5 per cent. of hydrous wool-fat has been added. The customary dose can be exceeded since the injections oridnarily need not be made oftener than once in five days. The usual quantity is 0.03 gm. (½ gr.), injected into the buttocks. Gray oil, which consists of mercury, hydrous wool-fat and olive oil, is more or less used for subcutaneous injection, and by some is preferred to any other preparation for this purpose, especially in infantile syphilis. In using mercurials hypodermatically it is important that the part is well rubbed immediately after the injection, so as to dispel the local accumulation of fluid, and that injections are not given on successive days at points near to each other. One of the evil effects which is liable to be produced by the continued and free administration of mercurials is nephritis, and it has been found that the safest method of mercurialization, so far as the kidneys are concerned, is by the hypodermatic employment of the corrosive chloride, while the most dangerous is probably the use of inunctions. Minor disadvantages are local soreness, occasionally headache, malaise or possibly diarrhœa which may be noted for a few days after the injection. Very deep intramuscular injections are advocated by some as not only almost painless, but productive of the best practical results because the dosage is exact and the frequent repetition of the treatment keep the patient under constant supervision.

(6) **Intravenous Injection.**—This method has been recommended by some as having certain advantages, one of them being stated to be more rapid absorption and therapeutic effect than by any other. It possesses certain disadvantages also, and the opinion has been expressed that it preferably should not be used in instances of syphilis easily amendable to ordinary treatment or in the early stages of the disease, though it is of special value in patients markedly resisting other treatment; also in advanced organic syphilis, especially cerebral or when immediate relief is urgently called for by reason of pain, encroachments on a vital part, or rapid destruction of tissue. Neither intravenous nor hypodermatic injection should be resorted to in the ordinary routine treatment of syphilis.

(7) **Fumigation.**—Mercurial fumigations often prove highly serviceable in syphilis, and by some the most satisfactory method of treating the secondary eruptions upon the skin is believed to be by fumigation with calomel two or three times a week, accompanied by the administration of the iodides internally, with tonics whenever necessary, and proper attention to the general health. The method is as follows: The patient, having taken a warm bath to prepare the skin for absorption, sits upon a chair and is covered with a large blanket or rubber cloth (a mackintosh serves very well for the purpose), which is gathered in closely about his neck and extends down to the floor, all around him. The mer-

curial preparation, 1.20 gm. (20 gr.) of calomel, is placed in a porcelain dish, over a spirit lamp, underneath the chair. The most satisfactory apparatus is one in which the alcohol flame sublimes the calomel and boils water at the same time, and is made of sheet iron. The center, on which the mercurial is placed, is flattened, and around this is a circular depression, which is about one-third filled with water. The heat produced generally causes profuse sweating, and the mercury, after having become volatilized, is deposited upon the cutaneous surface. In about twenty minutes the lamp is extinguished, and the patient is then wrapped in blankets and put in bed with the mercury still adhering to his skin.

(8) **Inhalation.**—Inhalation is occasionally used independently of fumigation, and not infrequently in connection with the latter, the mercurial preparation being volatilized in the same manner. When it is desired to practice it in conjunction with fumigation the patient is directed to inhale for two or three minutes at intervals during the bath. In doing this he should not put his head under the cloak or blanket but simply allow some of the vapor to escape from the upper part, and breathe it mixed with a large proportion of common air. When inhalations are employed separately the amount of calomel used should not exceed 0.30 gm. (5 gr.), and the face should be held six inches from the receptacle. Unless a local action on the buccal membrane is desired, it is advisable that the mouth should be rinsed out with potassium chlorate solution in order to prevent the occurrence of mercurial stomatitis.

(9) **Baths.**—Twelve grammes (3 dr.) of corrosive mercuric chloride, with 4 mils (1 fl. dr.) of hydrochloric acid, or of 4 to 8 gm. (1 to 2 dr.) of the mercury, with twice as much common salt, to each bath, were formerly used to some extent for syphilitic subjects with skin-lesions, but this mode is now obsolete. Remarkably successful results, however, have been recently reported in the treatment of small-pox, even of the most serious type, by means of corrosive sublimate baths. Twice a day a bath-tub is brought to the patient's bedside and filled with a warm (40.5°C.–105°F.) solution of the bichloride (1 to 10,000), when the patients are immersed, except the head and shoulders, for ten or twelve minutes, the nurse gently rubbing the entire body with a soft cloth during the bath.

TOXICOLOGY

Acute poisoning is not infrequently met with, and corrosive sublimate and white precipitate are the preparations usually taken. Corrosive mercuric chloride in toxic dose at once produces a metallic taste in the mouth and intense pain in the throat and stomach, quickly followed by severe retching and vomiting. If the amount wasted has been moderate, and this is more especially noted after the accidental taking of tablets of mercuric chloride, the symptoms may not appear for some hours or possibly for a day or so, and there may be but slight pain and few or insignificant other symptoms. The marked effect being almost entirely upon the kidneys; soon there is hæmatemesis, and violent purging also sets in, the stools at first being serous and afterwards bloody in character. The urine becomes very scanty, and contains albumin, blood and casts. The pulse becomes weak and rapid, the temperature is lowered, and there

is marked depression of all the vital powers, often ending fatally in a short time. After death the principal lesions customarily found are marked membranous colitis with extensive necrosis and parenchymatous and hæmorrhagic nephritis, with wide-spread degeneration of the renal epithelium and, less commonly, a peculiar deposit of calcium phosphate. *Treatment.*—In instances of acute poisoning the stomach should be evacuated by means of the stomach-tube, if possible. If this is not available, vomiting should be promoted by mustard and luke-warm water or by apomorphine hydrochloride, or by irritation of the fauces. Albumin, in the form of the white of an egg (one being sufficient for 0.24 gm. (4 gr.) of the corrosive chloride, the albuminate redissolving in an excess), milk and flour are useful. Tannic acid may also be given to protect the mucous membrane. If the symptoms and signs point almost entirely to the kidneys, and the course of the poisoning is more chronic, decapsulation of the kidneys may be desirable.

Chronic Poisoning.—Except in workers in mercury, this is now much more rarely observed than formerly, when it was the common practice to give large doses of the drug. The characteristic salivation, stomatitis, and other effects of mercurialization have already been described. Occasionally metabolism was so profoundly affected that the resulting cachexia ended in death. The tremor frequently seen in those who work with the metal and inhale the vapor resembles paralysis agitans, and the muscular weakness has been designated "mercurial palsy." Peripheral neuritis is extremely rare. A moderate but obstinate inflammation of the tongue or the lips, which proceeds to ulceration, sometimes extends, as gangrene, to the cheeks and produces a frightful deformity of the face. *Treatment.*—As in other chronic metallic poisonings, the object of the treatment should be to promote elimination by all possible channels. Sulphur baths and ordinary hot baths are of service. Diuretics may be given to assist the kidneys in carrying out the mercury, and the drinking of as much water as can be conveniently borne should be enjoined. The bowels should be kept free, but if diarrhœa is present it may call for treatment by opiates or other remedies. Opium is also sometimes required for the relief of pain, and the other symptoms should be treated on general principles. It is commonly believed that potassium and sodium iodide have some effect in causing the elimination of the metal, and while this claim has been disputed by some, it has never been disproved. Care should be taken, however, that the doses are not too large, since attention has been called to the fact that the combination of iodine with mercury in the tissues produces a soluble salt which is very active and which may secondarily cause general mercurial intoxication. Belladonna is sometimes required to diminish the excessive activity of the salivary glands, and generally a potassium chlorate solution is useful as a mouth-wash in the treatment of salivation and stomatitis. Incidentally it may be remarked that the free use of such a mouth-wash, together with frequent and careful brushing of the teeth, is of material service in warding off ptyalism during the continued administration of mercurials. Tincture of myrrh is frequently added to it, and tannic acid in solution is also sometimes employed as a mouth-lotion. Careful attention should always be paid to hygiene, and the general cachexia be combated by the most nutritious food, and such tonic or other remedies as may be called for. In establishments where mercury is used in the arts the same prophylaxis as in the case of lead is recommended.

FORMALDEHYDE

For the Preparations of Formaldehyde and Paraformaldehyde *see* p. 96.

Action of Formaldehyde

Formaldehyde and its polymeric form, Paraformaldehyde, is regarded as **equal in germicidal power to corrosive mercuric chloride,** while, on account of its volatility, which enables it to diffuse much more rapidly, it can be used for purposes for which the latter is not adapted. Formaldehyde gas may be produced (*a*) by warming the official solution; (*b*) by heating paraformaldehyde; (*c*) by adding calcium oxide, 16; to mixture of the solution of formaldehyde, 8; with ammonium sulphate, 6; 250 mils (8 oz.) of the solution thus prepared will generate enough gas to disinfect a room of the content of 1000 cubic feet, and is frequently employed by Boards of Health; (*d*) by adding potassium permanganate to the solution of formaldehyde. As the gas is given off with great rapidity a large receptacle for the mixture should be chosen. At the same time, it is only slightly poisonous to the higher animals. When the vapor is inhaled, its most characteristic effect is marked irritation of the respiratory mucous membrane, causing bronchial catarrh and a burning sensation in the nose and throat, even when present in very minute amount. It also excites increased secretion from the salivary and lachrymal glands. The powerful action of formaldehyde on microbes and on mucous membranes has been attributed to its combining with some amide group in the proteids. The urine of animals to which it is given, even in moderate quantities, is found to be incapable of putrefaction. Experimental research has shown that a 1 per cent. aqueous solution will destroy all pathogenic spores within an hour. The drug has also a very powerful influence on various forms of organic matter, one part in four thousand completely decolorizing wine, and precipitating the extractive and coloring matters. The efficiency of hexamethylenamine (*see* p. 574), much used as a genito-urinary antiseptic, is thought to be due to the liberation of formaldehyde from it. The penetrating power of the gas has been found to depend largely upon conditions of temperature, as it polymerizes below 11°C. (52°F.), and of moisture, and if this is marked, it may be considerable. It is not sufficiently powerful to destroy vermin or even small animals after many hours of exposure. When the watery

In both pneumonia and pleurisy large doses of calomel have been highly recommended by certain clinicians, but the weight of opinion is to the effect that mercury is of decidedly less value in parenchymatous inflammations, such as pneumonia and hepatitis, than in those of a serous character, like pleurisy, pericarditis and peritonitis. It should be carefully borne in mind that it ought never to be given in asthenic inflammatory conditions, and that in employing it as an antiphlogistic it should be exhibited during the stage of exudation, and to facilitate the absorption of the newly organized lymph. In the treatment of iritis the use of mercury has proved especially successful, and it is the common practice in this affection to push the remedy to the point of ptyalism whenever the tendency toward the exudation of lymph is marked. Although the matter has never as yet been practically demonstrated, there is considerable ground for the belief that the drug has the effect of diminishing the fibrin in the blood, and as in inflammatory conditions the latter is known to be increased, it has been supposed that there is a certain antagonism between the processes of mercurialization and of inflammation. On the other hand, many authorities believe that mercury has little or no remedial influence in acute inflammation, either in the serous membranes or elsewhere, and that as it is commonly combined with opium, whatever benefit is noted from such treatment in inflammatory affections is to be attributed to that drug. In iritis, in which the efficacy of mercurials is admitted by all, it is contended that the good result is due to the fact that this disease is almost universally of syphilitic origin. At present, the antiphlogistic use of mercury has undoubtedly become much more restricted. The various forms of the drug are now very commonly administered in the shape of triturates, made with sugar of milk, which contain about 10 per cent. of the mercurial preparation. Thus minutely subdivided, the remedy is found to be more readily absorbed.

Syphilis.—Undoubtedly the most important of all the uses of mercury is in the treatment of **syphilis,** even if we carefully value the results of administration of those preparations of arsenic which permit of massive dosage. While the results of massive doses of arsenic in the early stages of syphilis often seem, and really are, remarkable, the certainty and permanence of cure still requires the administration of mercury and, later, of the iodides. Like quinine in malarial fever, it is universally conceded to be a specific, although its

precise mode of action has not as yet been determined. While some have contended that its curative influence is due simply to the general effects upon metabolism, it seems altogether probable that this is attributable to a specific toxicity for the syphilitic germ, which, when the drug is adequately exhibited, finally results in the complete destruction of the latter. Some syphilographers hold that the action of mercury is to clear away from the tissues the products of a specific inflammation, or at least to relieve tissues encumbered with superfluous and obstructive material; but whether it develops a specific destructive action on the germ or not, the fact remains that mercury is employed in syphilis because experience has shown indisputably that it cures the disease. In order to secure the most satisfactory results it is requisite that its administration should be commenced at the earliest possible moment and that it should be continued for a considerable period after all manifestations of the disorder have disappeared. Its value in syphilitic condylomata, ulcerations, etc., has already been referred to, but here its local application is not sufficient, and an internal mercurial course should be entered upon just as soon as the diagnosis is established. This should never be discontinued under one year, and it is not infrequently necessary to maintain it, with periods of intermission, for several years. While all are agreed as to the efficacy of the drug in the first and second stages of syphilis, authorities differ as to its value in the third stage. As a rule, however, in the tertiary period it will be found that the best results can be obtained by mixed treatment, as it is called, mercurials in combination with the iodides, particularly potassium iodide. In most instances in which the disease is recognized early and in which mercurial treatment is promptly instituted and faithfully carried out, no tertiary symptoms occur and the use of the iodides is entirely uncalled for. The dose of the remedy should be carefully regulated in accordance with the circumstances of each individual patient. The effort should be made, it is recommended, to give the largest amount that can be borne without the production of gastric, buccal, or other irritation; in other words, to overwhelm the disease without detriment to the general condition of the patient. In the earlier stages the proto-salts of mercury (and particularly mercurous, known as the yellow, iodide) are considered the most serviceable; later in the disease, especially when used in conjunction with potassium iodide, it is customary to employ the per-salts, the

instances of septicæmia have apparently received benefit from intravenous administrations of formaldehyde in physiological saline solution.

CHLORINE

For the Preparations of Chlorine *see* p. 33.

Action of Chlorine

External.—Chlorine gas is **intensely irritating** to mucous membranes, and air containing even a small proportion of it affects the eyes, nose, fauces, larynx, bronchi and lungs. It acts more energetically upon the lower than upon the upper respiratory passages, so that an amount of the gas which gives rise to comparatively little irritation of the nose and pharnyx may excite bronchitis and pulmonary congestion and hæmorrhage. Applied to the cutaneous surface, chlorine water produces heat and redness, and, if the gas is prevented from escaping, will give rise to vesication. The germicidal action of chlorine is very pronounced, and in the presence of moisture it is one of the most powerful of **disinfectants** and **deodorizers.**

Internal.—Chlorine has a marked affinity for hydrogen, and as a result of its combining with the hydrogen of water, nascent oxygen is set free and acts on the tissues. When taken internally, a certain portion is converted into hydrochloric acid, which afterward becomes changed to chlorides during the process of absorption. A portion of it, however, it is believed, may form proteid compounds in the body. The claim that it is excreted in the free state in the urine is now held to be unfounded, but free chlorine may be recognized in the brain after death from its inhalation. It is poisonous chiefly by its local action. Except in small doses, chlorine water unless well diluted, causes corrosive and intense inflammation of the mouth, throat and stomach, with the production of collapse. After fatal poisoning from the inhalation of the gas, however, the gastric mucous membrane is found to be unaffected.

Therapeutics of Chlorine

External.—As a disinfectant chlorine has the disadvantage of injuring colored fabrics and wearing apparel. It may also cause dangerous symptoms in persons using it, unless handled with great

caution. It is regarded as inferior to sulphurous acid anhydride, and still more so to formaldehyde, not from its being weaker in action, but because it is more difficult to apply in sufficient quantity. The room to be disinfected by it should be hermetically sealed, after the removal or protection of all metals and of fabrics likely to be injured or bleached. The gas can be generated from common salt, 18; manganese dioxide, 15; and sulphuric acid, 45; in iced water, 21 parts; by weight. As it is heavier than atmospheric air, the vessel should be placed on a high shelf, in order that the chlorine may be diffused throughout the room. For chlorine disinfection of rooms chlorinated lime, with the addition of acid in excess, is used by many. To disinfect hands, moistened chlorinated lime is spread over the hands, next a large crystal of washing soda is held in the hands, and they are washed, with rubbing, under water until a cooling sensation is experienced. The best disinfectant for excreta is fresh chlorinated lime, 1; dissolved in water, 16; of which 1000 mils (1 qt.) is placed in the receptacle into which the dejecta are received, and left one hour. It may also be used with good effect in drains, sinks, closets, urinals, etc.

When exposed in the sick room, chlorinated lime acts rather as a deodorizer than as a disinfectant. The chlorinated preparations, in dilute solution, are very useful for destroying fetor in scarlet fever, diphtheria, and gangrene, and also in gangrenous wounds, sloughing ulcers, foul discharges, etc. A combination of the tincture of ferric chloride with potassium chlorate, in which some free chlorine is evolved, constitutes an excellent antiseptic gargle.

Internal.—Chlorine in 0.4 per cent. aqueous solution, is somewhat stimulant and tonic to the stomach. This and the solution of chlorinated soda may be employed as gargles. It has been successfully used, well diluted, in the diarrhœa of typhoid fever, particularly in markedly septic patients. After the administration of doses of 4 mils (1 fl. dr.) of the aqueous solution every hour the temperature falls, the intellect brightens, the tongue clears, and betterment goes on to recovery in many apparently hopeless patients. This remedy was formerly considered of service in chronic affections of the liver, but is seldom used now for the purpose of acting on this organ.

TOXICOLOGY

In poisoning with chlorine taken by the mouth, alkalies should be given to neutralize the acid formed, and albumin, in the form of eggs, etc., is also of

service. Narcotics may be called for to allay pain. In poisoning by inhalation, steam may be inhaled to diminish the irritation. Ammonia gas may also be given for the purpose of forming ammonium chloride, but it should be remembered that the ammonia is itself irritant, so that, in addition, demulcents should be used freely and persistently.

PHENOL

For the Preparations of Phenol *see* p. 105.

Action of Phenol

External.—Phenol is an **antizymotic** of considerable energy, and. while not so powerful as some other agents of this class, it is useful, In sufficient strength it is poisonous to all varieties of protoplasm, because it precipitates it. This is not a chemical reaction, for the phenol can be washed out of the tissues. But, like other antiseptics, it is much less toxic to microbes than to the protozoa and other simple forms of life. Again, it affects some species of microbes much less powerfully than others, and it has been found that it takes as long as two days for the destruction of the spores of the anthrax bacilli by a 5 per cent. solution. It has also been found, however, that the development and reproduction of many micro-organisms is greatly interfered with, or altogether prevented, as long as they remain in a solution of one part of phenol to 400 or 600 of water. It seems to be well established, moreover, that 1 per cent. in an aqueous solution will destroy with certainty the virulence of ordinary septic and purulent matter, and of the tubercle bacillus. While some of the putrefactive germs are also destroyed by solutions of this strength, it is requisite that the action should be maintained for about two hours in order to insure this, and for the destruction of the infection of vaccine and of glanders a 2 per cent. solution is required. In oily or alcoholic solutions the antiseptic influence of phenol is extremely slight, owing to its failure to ionize.

Phenol has the property of precipitating albumin and other proteids in solution, and its action in this respect has been compared with that of alcohol, in which the proteid is precipitated, not because an insoluble compound is formed, but because of a change in the nature of the solvent. Hence it is argued that this agent must penetrate more thoroughly than the metallic antiseptics, which are rendered insoluble by the albumin they meet. In sufficient concentration

phenol exerts a mild **escharotic** action. When applied momentarily to the cutaneous surface it produces at first a burning sensation and a white discoloration, followed by a reddish stain, which gradually fades away as the skin desquamates. If the application be prolonged, a white opaque scar is formed, which afterward becomes red and shining. When in the course of a few days it falls off, it leaves a light brown stain, which may persist for several weeks. If prevented from evaporating, the acid, by penetrating to the deeper tissues, may produce extensive **dry gangrene** of the part. Phenol is a decided **local anæsthetic.** The application of a solution even as weak as five per cent. at first cause a sensation of tingling and warmth, and this is followed by one of numbness. If the stronger solution is employed the numbness amounts to almost complete anæsthesia. Phenol is peculiar in that it dissolves with 10 per cent. of water; if more water be added, the phenol separates and complete solution again occurs when the water reaches 95 per cent. On the mucous membrane the drug has an escharotic effect which varies in degree according to the strength of the solution. Applied to wounds or abraded surface, a 5 per cent. solution causes pain and irritation.

Internal. *Gastro-intestinal Tract.*—When taken in concentrated form phenol causes burning pain, of short duration, and white eschars of the mouth, œsophagus and stomach (the mucous membrane appearing as if brushed over with a strong solution of silver nitrate and becoming hard and dry), and, if death does not result at once, it gives rise to violent gastro-enteritis, with its attendant vomiting and purging. The matters vomited have the characteristic odor of the drug. If taken in therapeutic doses, it produces a cooling and rather grateful sedative feeling in the stomach, and the bowels are unaffected by it.

Blood.—According to some observations the number of red blood-corpuscles is reduced. In toxic doses it sometimes appears to have a disintegrating effect on these cells. In one instance of poisoning the presence of hæmoglobin in the urine indicated the destruction of some of the corpuscles. While it gives rise to a gradual formation of methæmoglobin when added to defibrinated blood, it has been found that this does not take place in the living.

Circulation.—It has been demonstrated that one of the characteristic effects of phenol, given in large doses, is the reduction of the arterial pressure, principally due to depression of the vaso-motor

center in the medulla oblongata. Weakness and slowness of the heart are observed, though at an earlier period there is cardiac acceleration, which is thought to result from the direct action of the drug on the muscle or on the regulating nerves.

Respiration.—The respiration, like the heart, is accelerated, and as this quickening occurs previous to the increased muscular movement caused by the drug, it has been attributed to action on the medullary center, which is first stimulated and subsequently paralyzed; so that the breathing ultimately fails altogether.

Nervous System.—The most marked effects of phenol after its absorption into the blood are upon the central nervous system. In mammals it causes, with or without a preliminary stage of depression, marked muscular tremor, which at intervals is interrupted by sudden twitches in different muscles, and later by clonic convulsions. The movements grow progressively more feeble and appear at longer intervals, and the animal passes into a state of collapse, in which, however, the sensibility to pain is often preserved. Finally, death occurs from asphyxia. After very large doses the collapse may be immediate. No convulsions are observed, and the heart and respiration often cease simultaneously. Generally there is an increased secretion of saliva, perspiration and tears, which is thought to be of central origin and possibly associated with the nausea and vomiting present. Frequently also the temperature falls far below the normal. In man convulsions are comparatively rare, but delirium and excitement are sometimes seen. When the quantity taken is large, immediate unconsciousness may occur, and death result in a few minutes, but how far this is due to the extensive local corrosion and how far to direct action on the central nervous system is unknown The infrequency of convulsions in man has not as yet been accounted for. The pupils, it may be noted, are almost invariably contracted in phenol poisoning; which is doubtless due to paralysis of the radiating fibers, the circular fibers being left unopposed

Temperature.—Phenol, in sufficiently large doses, cause a reduction of temperature which is probably due to some alteration effected in the heat-regulating mechanism, resulting in an increase in the dissipation of heat. In instances of poisoning, however, the fall would seem to be very largely due to the collapse.

Urine.—It is of considerable interest that the production of phenol occurs normally in the body, and that it is a constituent of the urine

of man. It has been found to be constantly present also in normal fæces, and it is considered probable that the phenol is formed in the organism as a late product of the pancreatic digestion. Its elimination by the urine appears to be markedly affected by different diseases and conditions, being vastly increased in ileus, and diminished in anæmia, scurvy, tuberculosis and scrofula. One of the characteristic effects of the absorption of phenol is a peculiar **smokiness of the urine,** varying in intensity. It is often a dusky green, which may change to dark brown or even black. It has been found that the acid passes through the tissues largely unoxidized, but a certain proportion of it is partially oxidized to pyrocatechin and hydroquinone, which combine in the body with sulphuric and glycuronic acid and are excreted in the urine as double (ethereal) sulphates and phenol, pyrocatechin and hydroquinone glycuronates. Pyrocatechin and hydroquinone are unstable bodies, and their oxidation products are doubtless the cause of the dark urine; pyrocatechin can only exist in alkaline urine, so that it cannot be the cause of the dark color. The inorganic sulphates are usually absent. This is determined by the use of the barium chloride test, which does not precipitate the combined sulphates (sulphocarbolates), (Sonnenberg's test). The depth of the discoloration of the urine is said to depend on the quantity of dioxybenzols present, and not on that of phenol sulphate. Hence a darker shade is apt to be observed when the absorption of the drug has occurred from an open wound (which presents conditions especially favorable to oxidation) than from much larger amounts absorbed from the alimentary canal.

Therapeutics of Phenol

External.—Phenol was formerly employed in aqueous solution in the form of a spray, with the idea of rendering the surrounding air antiseptic, during surgical operations, and in the treatment of wounds in general but it has been largely superseded by agents recognized as more efficient. By some it is still held in esteem; phenol lotion (1 in 40) being used for the washing of wounds and phenolized gauze (bleached cotton gauze medicated with half its weight of a mixture of phenol, 1; resin, 4; paraffin, 4) as an **antiseptic** dressing. It is also employed to a considerable extent as a disinfectant for surgical instruments, soiled linen, and hospital apparatus, and as a disinfec-

tant and deodorant for bed-pans, privies, drains, etc. For the latter purposes and on the walls and floors the crude drug is preferable, as its principal impurity, cresol (cresylic acid) is a very powerful disinfectant, and because it is cheaper. As a local application phenol is employed in a great variety of conditions. It has sometimes been applied undiluted to wounds and burns, exerting a hæmostatic influence. Afterwards the surfaces are cleansed with sterilized water. In carbuncle or malignant pustule, after incision and scraping, the undiluted drug acts as an antiseptic, and also relieves pain by its anæsthetic effect. Among the other conditions in which its application, undiluted, has proved efficient may be mentioned ulcer of the cervix uteri, chronic endocervicitis and endometritis, lupus, mucous patches, condylomata and cauliform excrescences. In performing minor surgical operations **local anæsthesia** may be secured either by brushing over the surface with the pure drug or by bathing the part, when this is practicable, for ten minutes in a 30 per cent. glycerin solution. A solution (1 in 20) will alleviate itching from almost any cause, and on account of this anæsthetic action phenol has been called the "opium of the skin." Its anti-pruritic and parasiticidal qualities render it a useful remedy in a large variety of cutaneous affections. The glycerite is a very serviceable form, and it may be used (generally diluted) with good results in such affections as prurigo, tinea versicolor, tinea tonsurans, and the other forms of tinea. It is also applied as a stimulant to indolent ulcers and to the patches of aphthous stomatitis; it is very efficient in allaying the itching of jaundice. It has likewise been used to prevent pitting from smallpox, and an ointment containing phenol and camphor has proved of service in alleviating the itching accompanying that disease.

The strong (90 per cent.) phenol is generally successful in relieving the pain of a carious tooth, but the pledget of cotton on which it is inserted into the cavity should be covered with dry cotton, in order to prevent its coming into contact with the gum and possibly causing sloughing. In ulcerated sore throat, tonsillitis, diphtheria and other throat affections a 1 per cent. solution in water and glycerin is useful as a gargle or wash for cleansing purposes, and also for the alleviation of pain, while a concentrated solution in glycerin is sometimes applied as a mild caustic. In hay-fever, influenza and in acute and chronic nasal catarrh, also, weak solutions are topically used to a large extent (frequently by means of the atomizer), and a favorite

one is that of Dobell, which contains, in addition to phenol, sodium borate and sodium bicarbonate, with glycerin. In acute coryza the combination of the vapors of phenol and iodine is often very beneficial.

The deep-seated injection of phenol has been successfully practised in the treatment of lupus, ulcerations, poisoned wounds, erysipelas, secondary syphilitic abscesses, fistulæ, enlarged bursæ, synovitis, etc. In synovitis the injections are made into the affected joint. A solution of the strength of from 2 to 5 per cent. is commonly employed, but in the instance of hydrocœle the pure drug is sometimes injected intothe sac, after the removal of the fluid. Piles are also efficiently treated with injections of phenol, either pure or diluted with oil, but accidents have been reported from the procedure.

Internal.—Phenol is a very useful remedy in gastro-intestinal irritation, especially when associated with or dependent upon fermentative changes from imperfect digestion, and also where the disturbance is characterized by a nervous element. Vomiting and flatulence, as well as gastrodynia, may often be relieved by it, and it is of great service in many instances of diarrhœa. For the latter condition it is very generally combined with bismuth subnitrate (0.60 gm.; 10 gr.), and administered either in emulsion or in capsules. Remarkable results from phenol have been reported in the treatment of **scarlet fever.** Under this plan, the drug is given in doses of from 0.06 to 0.36 gm. (1 to 6 gr.), according to the age of the child, freely diluted, every two hours. The remedy is pressed to the point of causing carboluria, and this condition is maintained until the fever is fully abated. It has been found that renal complications, which ordinarily occur quite frequently in this disease, are exceedingly rare; while the patients thus treated show in other respects very mild symptoms. Evidence has been presented of the value of large doses of phenol in the treatment of influenza, particularly in the later stages of the disease, which often proves so intractable. In tetanus it is claimed that as good results have been obtained as from the use of antitoxin. It is usually given hypodermatically in a 2 per cent. solution, from 0.30 to 1 gm. (5 to 15 gr.) being administered in the twenty-four hours. Its use is advocated on the ground that in addition to being an antidote to the toxin, it acts as an anæsthetic and general antiseptic. In erysipelas it has been given by the mouth and subcutaneously, as well as by deep-seated injection at the affected part. Large doses by hypodermatic injection have been recommended in bubonic plague, and instances of

recovery have been reported. Phenol appears to have a distinctly curative effect in malarial fevers, and the combination of this with iodine in chronic malarial infection, as well as in the more acute forms after quinine has stopped the paroxysms, has been found of great value. In gangrene of the lung the internal administration of phenol combined with the use of a weak phenol solution by atomization is said to be advantageous. In this condition, however, as well as in pulmonary tuberculosis, creosote is generally considered preferable at the present time. And it must be remembered that collapse is readily caused by phenol, with weak cardiac action, vaso-motor paralysis, and respiratory feebleness, so that its internal use is fraught with danger.

Cresol (*see* p. 107) has an action very similar to that of phenol, while its germicidal power is said to be nearly three times as great as that of the latter. It may be used internally and in surgery for the same purposes.

TOXICOLOGY

Phenol is employed for suicidal purposes far more frequently than any other poison, principally for the reason that it can be so readily obtained, and, also, no doubt, because its lethal action, if the dose is sufficiently large, is so extremely prompt. Coma supervenes immediately and death has been known to occur within three minutes. In surgical practice the free use of the drug is not unattended with danger. Instances have been observed in which patients have passed, immediately after the application of phenol dressings, into a condition of collapse similar to the shock following severe injuries or surgical operations. In other instances the poisoning occurs gradually and insiduously and may be mistaken for septicæmia. The correct diagnosis can be determined by an examination of the urine in which the phenol is found partly unchanged and partly oxdized to hydroquinone or pyrocatechin; the inorganic sulphates are absent, the ethereal sulphates taking their places. Instances have been cited in which, in addition to wounded surfaces, poisoning has occurred from absorption from the skin, the rectum, and the uterine and other cavities. The effects of the drug when taken by the mouth have already been described. Besides the local action of the phenol, the warnings of danger have been pointed out to be sudden vertigo, contracted pupils, pallor of the face, enfeebled circulation, and embarrassed respiration. The symptoms frequently resemble very closely those of apoplexy, but the odor of phenol may generally be detected in the breath and the characteristic corrosion produced by the acid will be found to be present on examination of the mouth. It is a fact deserving of note that in some instances where consciousness has been restored and the condition otherwise become markedly improved, the patient, after a number of hours, sank rather suddenly into fatal collapse. With smaller doses, which are not immediately fatal, the destruction of tissues

is marked, collapse with muscular tremor follows, and later the patient may die from respiratory paralysis. Should the patient recover, cicatricial stricture of the œsophagus, or cicatrices in the other portions of the upper alimentary tract may eventually cause death.

Post-mortem.—If death has occurred quickly, the tissues and organs will smell distinctly of the drug. The mucous membrane of the mouth, pharynx, œsophagus and stomach, wherever acted upon by the poison, is found to be corrugated, tough and discolored. It is generally whitish, changing to a brownish color, and the corrosions may be surrounded by a zone of inflammatory redness. In some instances, where the pure liquid drug has been swallowed, the appearance is that of a broad chocolate-colored slough, extending continuously from the lips down into the stomach, and involving more or less of the gastric mucous membrane. The blood is dark-colored, and generally coagulated in the heart and great venous trunks, although it has been maintained by some authorities, that in the consequence of the alteration in its character caused by the drug, it coagulates with difficulty. While, however, the heart may be distended with loose clots, it is sometimes found empty and contracted. Acute fatty degeneration of the heart, as well as of the liver, kidneys and other organs, it is asserted, has been found in some instances.

Treatment.—Many of the instances of poisoning met with, present very little hope of amelioration from whatever measures may be adopted. If the drug has been taken by the mouth, the stomach should be promptly evacuated by means of the stomach-pump or the hypodermatic administration of apomorphine hydrochloride, and demulcents, such as white of egg or thick soap-suds, given. Saccharated lime should be administered, in the hope that an insoluble combination may be formed in the stomach. Soap is also considered a chemical antidote. In view of the fact that in the tissues phenol forms a comparatively harmless compound with sulphuric acid, the exhibition of sodium sulphate has been advocated by many authorities; but it is stated that practically this is of little or no benefit, either because the tissues are entirely paralyzed by the excess of phenol, or more probably because the latter does not combine with sulphates as such in the body, but with organic sulphur compounds which are only in process of being oxidized to sulphuric acid. It is of the utmost importance to immediately give stimulants freely, such as ether or brandy subcutaneously. **Alcohol** should be given by the mouth, as phenol does not ionize in it; pure **alcohol** is the most **important antidote** to phenol known. Success in this treatment demands that the drug and alcohol should be brought into contact; therefore if the drug has been swallowed for some time alcohol may not be efficacious. This should be at once followed by a solution of magnesium or sodium sulphate. Atropine has also been recommended as an antidote, experiments on animals showing results which point strongly to the existence of the antagonism, and it is reported to have succeeded in some very unpromising patients. At all events, such stimulants to the central nervous system as atropine, camphor and caffeine are generally called for, and artificial respiration should be resorted to in all serious instances. Hot applications and friction should also be employed to combat collapse. Cider vinegar is stated to be one of the antidotes of phenol, having the effect when applied to a cutaneous or mucous surface which has been burnt by it of causing

the prompt disappearance of the characteristic white eschar produced by the drug, and also of preventing subsequent scarring to a large extent. As it is supposed to be equally efficacious when the poison has been taken into the stomach, vinegar diluted with an equal quantity of water may be given if the patient is able to swallow. This article has the advantage of being always procurable without delay. The patient's bowels should be moved with sodium or magnesium sulphate, and it is advised that the soluble sulphates should be administered in small doses for several days, with the idea of facilitating the elimination of the phenol from the system.

THE PHENOLSULPHONATES

For the Preparations of the Phenolsulphonates *see* p. 106.

Action of the Phenolsulphonates

Sodium phenolsulphonate is less irritant and less poisonous than phenol, and while it is also stated to possess less antiseptic power, has considerable efficiency as a **gastro-intestinal antiseptic** and disinfectant. It does not cause smoky discoloration of the urine, and appears to be excreted in that fluid unchanged. The action of zinc phenolsulphonate is the same as that of the sodium salt except that it is more astringent.

Therapeutics of the Phenolsulphonates

The phenolsulphonates were introduced for the purpose of securing, if possible, the antiseptic and antipyretic action of phenol without the caustic and depressing action of the drug. While sodium phenolsulphonate does not perhaps altogether maintain the position anticipated for it, it may in some instances be used with advantage as a **substitute for phenol.** It has also been given in typhoid fever and other infectious diseases, such as septicæmia, puerperal fever, and the exanthemata, and successful instances have been reported from its use even in malignant endocarditis.

Zinc phenolsulphonate is employed as an astringent for indolent or foul ulcers, and in subacute inflammations of mucous membrane, in solutions which are somewhat stronger than those of zinc sulphate in use. Internally it has been used as an intestinal antiseptic, and has been recommended in typhoid fever as having the advantage, over the phenol and iodine treatment, of being less depressing to the heart and less injurious to the kidneys.

TRINITROPHENOL

For the Preparation of Trinitrophenol *see* p. 108.

Action of Trinitrophenol

Trinitrophenol is **antiseptic and analgesic** but to a less extent than phenol; it acts similarly but less powerfully upon infusoria than does quinine. It coagulates albumin and in solution is not irritant to the arteries.

Internally it has produced vomiting, weakness, diarrhœa, strangury, anuria and collapse, which is sometimes preceded by convulsions. The skin and mucous membranes may be stained yellow.

Therapeutics of Trinitrophenol

On account of its **antiseptic properties** it has been used externally in a saturated aqueous solution as a local application in the treatment of erysipelas and burns. In the latter use it has given rise to nausea and vomiting, rise of temperature and pulse and the urine has become a dark port-wine color and contained albumin but no blood, hæmoglobin or bile. The skin was yellowed especially on the palms and soles; there was also a coloring of the conjunctivæ and the skin at the border of the hair. In another instance it caused swelling and vesiculation of the face, a scarlet rash over the whole body, which was accompanied with marked itching. The eruption disappeared with desquamation only after fourteen days. In eczema it has been applied on cotton moistened with a saturated solution and covered with cotton and held in place with a bandage. Thus applied it causes smarting and itching which soon gives place to a feeling of comfort. This dressing may be repeated every two or three days but must not be applied over extensive surfaces for fear of absorption. It has also been employed as irrigation in gonorrhœa, 1 part of the saturated aqueous solution to 5 parts of water. In instances of acute disease it diminishes the discharge very rapidly and in chronic conditions improvement commences at once. If introduced into the bladder this diluted solution causes practically no pain and the strength may be increased.

It would appear to be too corrosive to be used internally as such; even its salts, none of which are official, are decidedly irritant.

IODOFORM

For the Preparation of Iodoform *see* p. 100.

Action of Iodoform

External.—Locally iodoform is capable of inducing **analgesia** of the rectum and the bladder, and when applied in considerable quantity to wounded surfaces also has an anæsthetic effect. In exceptional instances (for the most part confined to individuals with a predisposition to cutaneous affections) it gives rise to a certain amount of irritation and even to papular or eczematous eruptions. Although it was formerly believed to be of pronounced antiseptic value, it has since been demonstrated that this was a misapprehension; pathogenic microbes frequently developing as rapidly after having been exposed to its action as in the control cultures. When it was shown that iodoform itself has no germicidal properties, the theory was advanced that it only acts as an antiseptic after its decomposition, this resulting in the liberation of free iodine, which exerts an antiseptic influence. This is only true in moist wounds or tissues where this change may take place to some extent. More recent investigations indicate that microbes found in wounds under iodoform treatment are not retarded or weakened in their development; proving, apparently, that the beneficial effects of such treatment are not due to any poisonous action on the germs. At present it is held that whatever benefits attend the use of iodoform dressings must be explained on the ground of a supposed action on the wounded surface, in consequence of which it secretes less fluid, and thus affords a less suitable medium for the growth of the germs. It is thought also that such growth may to some extent be retarded by the formation, by the iodoform, of a crust, which mechanically prevents microbes from penetrating to the wounded surface. The favorable results which have been observed from the application of iodoform to tuberculous ulcers, tuberculous abscesses, and similar conditions are probably due to its **beneficial effect on the granulation tissue,** rather than to a specific action upon tuberculous disease.

Internal.—From moderate amounts of iodoform the most constant symptoms produced are headache, more or less nausea and vomiting, and an unpleasant taste and smell from the drug. When it is taken in larger quantities the headache is accompanied with giddiness, and

the patient is restless, uncomfortable, and unable to sleep. The heart is feeble and accelerated, the pulse sometimes reaching 180, and there is a rise of temperature to 104°F., or even higher. From the first there is anxiety and a general depression which increases as the poisoning progresses. This deepens into melancholia, with hallucinations, generally succeeded by violent delirium and mania, which may last for days or terminate in a shorter time in fatal collapse. In exceptional instances there is an entire absence of signs of cerebral excitement, and the patient sinks into a profound sleep, ending in coma and collapse. Of all the symptoms of iodoform intoxication the most characteristic are the delirium and mania. They are not developed in the same intensity and of equal duration by any other poison, but it is not known what changes take place in the brain. The cerebral symptoms appear to be attributable to iodoform which circulates unchanged in the blood. Some of the other symptoms are no doubt due to iodine set free by the decomposition of a considerable portion of the iodoform and to the iodides which some of the nascent iodine forms by combining with the alkalies of the fluids. After absorption, iodine is present in the saliva, perspiration and other secretions, but it is found to be chiefly excreted in the urine in the form of iodides. The elimination from the tissues seems to be very slow, since iodides are stated to have been detected in the urine more than a month after the administration of iodoform. When renal disease is present, the drug should always be used with caution, as under these circumstances excretion takes place even more slowly than usual, and the iodoform products are liable to accumulate in the tissues. The cardiac acceleration noted is thought to be probably caused by abnormal activity of the cells of the thyroid gland, as the thyroid secretion has been found to be very considerably increased by iodoform, as by other substances from which iodine is liberated in the tissues. Children, it is stated, are less susceptible to the poisonous effects of iodoform than adults. While the drug is absorbed slowly by the alimentary canal, it is taken up quite freely from wounds, or when injected into cavities and many instances of poisoning have occurred in this way.

Therapeutics of Iodoform

External.—Whatever may be the explanation of its local action, there can be no question of the great practical value of iodoform as a

surgical dressing. While, on account of its extremely disagreeable odor and the numerous accidents which have attended its use, various substitutes for it have been proposed and have proved more or less successful, yet it is employed to a very considerable extent. One of its most important applications, and that which first directed general attention to its usefulness, is as a dressing for wounds. The common practice is to sprinkle it freely upon the part and secure it in place by a dry dressing. Since iodoform is not, as explained above, itself antiseptic, it must, before being used, be either sterilized or disinfected by washing in a 1 to 2000 solution of corrosive mercuric chloride solution, and preserved, while damp, in closed sterilized jars. It is employed in the treatment of all sorts of wounds and ulcers, and is found especially **serviceable in tuberculous and syphilitic ulcerations.** Usually the dry powder is simply dusted upon them, but iodoform is also employed in a variety of different combinations. One of these is a solution in collodion (1 part of iodoform to 12 of flexible collodion), which is painted over wounds, venereal sores, etc., with good effect. Another is a mixture of equal parts of iodoform, glycerin and alcohol, sometimes called an emulsion, which is used for injecting tuberculous abscesses. For the relief of chronic cystitis injections have been given of iodoform dissolved in ether (1 in 8), of iodoform, starch and water, and of a solution of iodoform in glycerin and water. In fissure of the anus and in diseased and painful conditions of the rectum an iodoform suppository containing 0.20 gm. (3 gr.) in 1 gm. (15 gr.) of oil of theobroma serves an excellent purpose. Similar vaginal suppositories have been largely used in affections of the uterus and vagina, and powdered iodoform is sometimes introduced into the dilated cervix uteri by insufflation. In the uterus, the urethra and the nose, as well as in sinuses and other deep and narrow cavities, bougies made with cocoa butter, mucilage and glycerin, or gelatin, may be employed. Mixed with bismuth subnitrate and starch it is used with benefit, by insufflation, for ozæna, ulcers of the mouth and fauces, and tuberculous ulcerations of the larynx. Syphilitic ulcers of the pharynx are sometimes treated with the ethereal solution and with gelatin lozenges each containing 0.12 gm. (2 gr.) of iodoform. In ozæna, iodoform may be used in an ointment, or by means of absorbent cotton impregnated with it, instead of by insufflation. Iodoform cotton is useful as an applica-

tion to the rectum and vagina, as well as to the nostrils. In chronic suppuration of the middle ear, but more especially of the external auditory canal, it is regarded by many as excelling all other applications in diminishing the discharge and correcting its fetor. Iodoform gauze, which may be made by saturating the material with a concentrated ethereal solution and afterwards drying, is much used in operations involving the peritoneum, intestine, etc., and in contused wounds where drainage is required. It is efficient also in the treatment of open cancer, buboes, boils and carbuncles after incision, many of the lesions of scrofula, lupus and syphilis, and a variety of other conditions. A novel use has recently been made of the drug, in the form of "iodoform plugs," employed for filling up cavities produced by diseased tissues, and the treatment is stated to have been especially successful in bone cavities. They are composed as follows: Iodoform, 6; spermaceti, 4; sesame oil, 2. In exceptional instances iodoform, instead of having a healing and beneficial effect upon wounds, sores, ulcers, etc., causes marked irritation, necessitating its replacement by other applications. As the disagreeable odor of iodoform constitutes a very serious objection to its use, various means have been tried to obviate this, as musk, balsam of Peru, and the oils of eucalyptus, turpentine, bergamot, peppermint, sassafras, cinnamon, lavender and thyme. Some believe that the odor of iodoform is preferable to that of musk. It is claimed that the odor will rapidly disappear from the hands of the surgeon if they be washed with orange flower water or with linseed meal in water, or, as has been recommended, in vinegar. It has been pointed out also that as chloroform and ether are solvents of iodoform, they may be successfully used for removing its odor from the hands, nails and clothing.

Internal.—On account of the great success of iodoform in surgery as a supposed antiseptic, it was anticipated that it would prove of decided benefit internally in many of the infectious diseases, and, on account of the large amount of iodine in its composition (with the advantages of being non-irritant and being of an organic nature), more sepecially in such affections as syphilis, scrofula and tuberculosis. It was therefore given an extended trial, both by the mouth and by subcutaneous injection; but the expectations in regard to its efficacy were not realized.

TOXICOLOGY

Many deaths have been occasioned by the free use of iodoform as an external application, and in the aged especially, more or less severe poisoning is liable to occur. Poisoning may be avoided if one does not use large quantities of the remedy, the wound is not subjected to pressure, and if phenol is not employed at the same time. It is a recognized fact, however, that in certain individuals there is an idiosyncrasy which renders them peculiarly susceptible to the action of the iodides in general, and often particularly so to iodoform. It has been found that in some instances this develops suddenly and without warning; grave toxic symptoms occurring at once and death quickly ensuing, notwithstanding the withdrawal of the remedy.

Symptoms.—These have been described on p. 314.

Post-mortem.—Fatty degeneration of the heart, liver, kidneys and muscles is generally found. Among the other conditions observed are ecchymoses in the kidneys, beneath the endocardium, and in other parts of the body, congestion of the meninges, and reddening of the mucous membrane of the gastro-intestinal tract, frequently associated with degeneration of the epithelial cells.

Treatment.—The first measure to be adopted is the complete removal of all iodoform that has been applied and the washing of the part with a solution of sodium bicarbonate. In the milder instances nothing further than this may be required; in more serious ones stimulants are called for, and small doses of tincture of opium frequently repeated, are recommended as being especially useful. At the same time elimination should be promoted by sponging the body with warm water and the free administration of diaphoretics and diluents, such as potassium acetate, lemonade, etc. Potassium bicarbonate, 0.60 gm. (10 gr.) of which, may be given every hour, is thought to have the effect of counteracting the toxic effects of iodoform, and potassium bromide, which is more active as a solvent for this substance than any other salt, is also considered an antidote.

BORIC ACID, SODIUM BORATE AND PERBORATE

For the Preparations of Boric Acid, Sodium Borate and Perborate *see* p. 55.

Action of Boric Acid, Sodium Borate and Perborate

External.—While boric acid and the borates are inefficient as germicides, they have some antiseptic power. The growth of almost all forms of bacilli is arrested by a 2½ per cent. solution, but the microbes are not destroyed, and it is stated that even the anthrax bacilli are capable of growth after exposure to a 4 per cent. solution for twenty-four hours. They would seem, therefore, to be of service as **mild antiseptics,** but to be valueless as disinfectants. A saturated solution of boric acid in broth will prevent putrefaction, and this agent is employed to a large extent in the preservation of milk, meats

and other kinds of food. When applied in concentrated form to denuded surfaces, it is somewhat irritating and mildly astringent; in solution, while slightly astringent, it is sedative rather than irritating. Sodium borate and perborate have no irritant effects. Their alkalinity renders them cleansing agents of efficiency and also adds to their sedative action; in addition the perborate gives up hydrogen dioxide on contact with water. Their prolonged use, as well as that of boric acid, is liable to give rise to scaly eruptions of the skin.

Internal.—In moderate amount sodium borate does not affect the digestion and assimilation of food, but larger quantities retard the absorption of proteids and fats and increase the bulk of fæces. Both substances are found to be rapidly absorbed from the bowel, and not to affect the intestinal putrefaction. Their excretion, which occurs principally by the urine, is completed within twenty-four hours. The urine is rendered alkaline by the borate, if taken in sufficient amounts; while boric acid, which is excreted in part unchanged and in part as borates, increases its acidity. Both these substances have generally been regarded as having some diuretic effect, but later researches show that the urine is really diminished in amount under their use. The borate is thought to have a stimulating influence upon the uterus, and is said to have produced abortion in certain instances. Sometimes even moderate amounts of these substances have a mild aperient action, while in large doses they are gastro-intestinal irritants, and cause vomiting and purging. Other symptoms produced by toxic quantities are dryness of the throat and dysphagia, profound muscular weakness, lumbar pain and vesical tenesmus, with albuminuria and sometimes hæmaturia, dimness of vision, headache, sleeplessness, and nervous depression, which may be followed by fatal collapse. A rise of temperature is frequently observed, and in the course of two or three days, if death does not previously occur, eruptions which are described as scaly, papular, or eczematous, appear upon the skin. When the drug is given by the mouth, nausea, vomiting and diarrhœa are apt to appear earlier and be more severe than if used in any other way, but these symptoms may result from its free application in the rectum, vagina and other parts. There is rapid absorption from all mucous membranes and from lesions, and serious poisoning has been reported from the use of boric acid as an antiseptic dressing. In chronic

poisoning, known as **borism**, the symptoms are often much the same as in instances of acute poisoning. The cutaneous manifestations, however, are more prominent, and may constitute the only positive indication of toxic action, although there are generally evidences of more or less renal and gastro-intestinal irritation Œdema of the face and extremities may occur in consequence of the former, and it is advisable that whenever these drugs are given in full doses, a careful watch should be kept upon the urine. The hair is apt to become dry and fall out, and the eruption on the skin may assume the form of seborrhœic eczema, reddish patches which desquamate like psoriasis, or papules attended with much itching. The commonest form of eruption is one, resembling seborrhœic dermatitis, but usually attended with much more œdema. In some instances there is marked dryness of the skin and mucous membranes, with fissuring of the lips and striation of the nails, and a bluish-gray line suggesting, but not resembling, that of lead poisoning, has been observed upon the gums. The effect of the continued and habitual introduction into the body of boric acid or sodium borate, as employed in the preservation of food, is of great interest. The results of recent experiments show, on the whole, that 0.50 gm. (7½ gr.) a day is too much for the normal man to receive *regularly;* while on the other hand the normal man can receive this amount of boric acid, or of borate expressed in terms of boric acid, for a limited period of time without much danger of impairment of health. It would appear to be established by these experiments that foods preserved by boric acid are much inferior to fresh foods; a fact which would seem to be obvious. The main objection to the use, as food preservatives, of these and other antiseptics, which are harmless in small doses, seems to rest upon the fraud in permitting inferior goods to be disposed of. This applies particularly to meats and milk, although the addition of small quantities may sometimes be beneficial by delaying the souring of the latter. If larger amounts are used for fraudulent purposes, the milk is apt to be kept too long and be of inferior quality, while the quantity of preservative may be sufficient to prove injurious to infants taking it habitually.

Therapeutics of Boric Acid, Sodium Borate and Perborate

External.—These drugs are used to a much greater extent externally than internally, and, especially on account of their non-irritat-

ing qualities, are largely employed as **local antiseptics.** Occasionally they are used in powder. The saturated solution of boric acid (4 per cent.) may be applied to wounds, ulcers and sores to protect them against infection or decomposition. It is especially recommended in the troublesome form of tinea known as trichophytosis genito-curalis, which affects the scrotum and inner side of the thigh, and it is considered the best remedy for fetid perspiration, especially of the feet. It is also of service when there are purulent discharges, as in otorrhœa and leucorrhœa, and to wash out cavities after operations. The irrigation should not be continued too long, however, as toxic symptoms have been produced in this way, especially in colitis. Boric acid solutions are useful in conjunctivitis and other inflammations of the mucous membranes, and, applied upon lint or absorbent cotton, as a dressing for burns and scalds. The glycerite of boroglycerin, well diluted, also answers well as an antiseptic lotion in ophthalmia, ozæna, pharyngitis, urethritis, vaginitis, etc., and likewise for wounds and granulating surfaces. For washing out the bladder in cystitis Thompson's solution (consisting of sodium borate, 1; glycerin, 2; water, 2), diluted with eight times as much water, is employed; and one of the most important antiseptic solutions is that of Thiersch, consisting of boric acid, 12; salicylic acid, 2; water, 1000. For sunburn, pruritus and other skin affections, as well as for wounds, ulcers, etc., boric acid ointment will often be found serviceable. Lister's ointment consists of boric acid, 1; white wax, 1; paraffin, 2; almond oil, 2. For application to extensive burns it should be diluted. Boric lint and borated cotton, made by wetting the materials in a boiling saturated solution of boric acid are used in surgery, gynæcology, etc. The external use, as well as the internal administration, of boric acid and the borates should be undertaken with caution when disease of the kidneys is present. Boric acid may be used to preserve solutions intended for hypodermatic use.

Internal.—Internally boric acid is almost exclusively given for **correcting the fetor** of fermentative dyspepsia and in instances of cystitis with decomposing urine, especially when the cystitis is the result of disease of the spinal cord, where it is also used in solution for irrigation of the bladder. In ammoniacal cystitis it tends to render the urine acid (probably by checking the fermentation, and also because it is excreted in part as boric acid), and has a beneficial effect upon the vesical mucous membrane. It should be given in full doses,

in diluted aqueous solution, and its administration should occasionally be suspended. Sodium borate is of service in relieving irritability of the bladder. It has been tried to a considerable extent in epilepsy, but while far less efficient than the bromides, it is, in the quantity in which it is required to produce any effect in this disease, much more dangerous. It is apparently of most service in patients where these agents fail and in those in whom the epilepsy is associated with gross organic disease. Among the other conditions in which it has been employed are dysmenorrhœa, amenorrhœa and uterine hæmorrhage, as well as inertia of the uterus during labor. It is sometimes taken in very large doses for the purpose of criminally causing abortion. That it really has any action on the uterus would seem to be problematical. It is thought to be of value as a solvent for uric acid calculi; but here again grave doubts have been expressed as to its efficacy. The unpleasant taste of sodium borate may be concealed by licorice, or by syrup of orange peel.

Sodium perborate in the presence of water is decomposed into hydrogen dioxide (*see* p. 325) and sodium metaborate. In some respects it is more useful than hydrogen dioxide because it produces an alkaline solution on decomposition.

POTASSIUM PERMANGANATE

For the Preparations of Potassium Permanganate *see* p. 88.

Action of Potassium Permanganate

External.—When dry, it is a permanent salt, but in the presence of moisture it rapidly gives up its oxygen and is converted into manganese dioxide. In powder form it acts as a mild caustic. In concentrated solutions it causes irritation and even corrosion of the skin. When a solution comes in contact with proteids, such as albumin, it at once parts with some of the oxygen which it contains, and the latter unites with the albumin. It is therefore a **powerful oxidizing agent** and, in consequence, is poisonous to protoplasm. It has very considerable germicidal activity, but this is short-lived for the reason that it so quickly parts with its oxygen; after which it becomes inert. Except in very superficial infections however, its antiseptic value is less than that of many other agents, since, on account of

the rapidity of its reduction, it fails to penetrate deeply, and its action is limited to the skin and the surface of the mucous membranes. Within a limited sphere it is a very efficient **disinfectant** and **deodorant.**

Internal.—It is not absorbed in sufficient amount to have any general action. When taken in poisonous quantities, the resulting phenomena are entirely local, as gastro-enteritis, and irritation or inflammation of the kidneys. The lack of general action, according to some authorities, holds true even when it is introduced into the circulation by subcutaneous or intravenous injection. According to others, in acute poisoning the blood-pressure falls, from depression and paralysis of the vaso-motor center, while the heart is not affected until much later. Injected thus into the circulation, it is excreted principally by the intestinal epithelium and to a smaller extent by the kidneys. When taken by the mouth, very little appears to be absorbed from the stomach and intestine. In the mouth, weak solutions of potassium permanganate have a sweetish but astringent and unpleasant taste, and there, as well as in the stomach, it is quickly reduced to the dioxide and loses its oxidizing power. On account of its caustic action this remedy, when taken in the form of pills or tablets, sometimes occasions considerable gastric irritation, and pain. In the blood, traces of manganese are very frequently found, but it has been shown that this metal is not an essential constituent of the body; being apparently absorbed accidentally with the food. The theory that manganese salts could replace iron in the body has been proved to be untenable.

Therapeutics of Potassium Permanganate

External.—One objection to its use, when large quantities are required, is its expense; another is that it stains fabrics. The stain may be removed by the application of sulphurous acid, but as this results in the formation of sulphuric acid, the fabric should be promptly rinsed in water. As an antiseptic it may be used to wash wounds, sores and ulcers in a 1 per cent. solution. For application to mucous membranes, as in a gargle or lotion for cleansing the throat in diphtheria, scarlet fever, and other diseases, the proportion should be about 1 to 400. Such solutions are employed in necrosis of the jaw, cancer of the tongue, and generally in affections causing foul breath.

They are useful also for correcting fetor in various other conditions, such as ozæna, bromidrosis of the feet, etc. Solutions of the strength 1 to 2000 may be employed as injections for gonorrhœa and leucorrhœa, and for washing out the stomach, bladder, uterus, abscess cavities, etc. One advantage connected with the use of potassium permanganate in this way is that it can be readily seen when it has lost its efficiency by the change in the color of its solutions. As soon as it has become reduced to the dioxide, by giving up its oxygen, these turn dark brown, and so long therefore as such injections return with their pink color retained, the assurance may be felt that the parts are being properly cleansed. It is asserted that potassium permanganate, owing to its properties as an oxidizing agent, is the most efficient antidote to snake-venom, if placed in the wound before the poison is absorbed. It is also recommended that it should be injected subcutaneously about the seat of the bite. As a local application in erysipelas its solutions have been found beneficial. It will relieve the burning and itching of rhus poisoning when continuously applied. As a deodorizer for sputa, stools, drains, etc., and for washing utensils it is used in the proportion of about 1 to 150. Condy's fluid is a solution of 1 to 60 in distilled water.

Internal.—On account of its disagreeable taste, potassium permanganate should be given in the form of pills or compressed tablets. As many substances tend to reduce it, the pills should be made with kaolin and soft paraffin, but oil of theobroma and rosin cerate are also used as excipients. For the dyspepsia and flatulence which so constantly accompany excessive fat, and also for the reduction of the obesity itself, the permanganate is a remedy of considerable value. It often affords relief to patients suffering from lithæmic conditions, with pain in the lumbar region and intestinal indigestion, associated with frequent micturition, acid urine, and much brick-dust sediment; while it favors the conversion of uric acid into urea, and thus tends to prevent the formation of uric acid calculi. Potassium permanganate has been much extolled as an emmenagogue, but in the large doses in which it is advised for this purpose (30 gm.; 5 gr.), it is almost certain to create gastric disturbance. Very few stomachs will tolerate more than 1 gr. and as it is in fact reduced in the stomach to the dioxide, that salt is preferable in amenorrhœa (*see* p. 802). If manganese is of any use in anæmia, which has not yet been proved, it probably acts in the same way as iron. The iron-manganese prepa-

rations, so much lauded, owe their efficiency, if they possess any, to the iron which they contain in varying amounts. Potassium permanganate oxidizes morphine, and other alkaloids, hydrocyanic acid and phenol, and is therefore a chemical antidote in poisoning by these substances. In **morphine poisoning,** about 0.12 gm. (2 gr.) in solution should be given for each grain (estimated) swallowed, and the stomach should be immediately and repeatedly washed out with repetitions of the antidote, because it has been shown that during the acute stage of morphine poisoning there is a continuous excretion from the walls of the stomach of the morphine, which is subsequently reabsorbed either from the stomach or the intestine. Potassium permanganate has also been recommended, internally, as well as locally, in snakebite and erysipelas, and in septicæmia and puerperal fever.

HYDROGEN DIOXIDE

For the Preparation of Hydrogen Dioxide *see* p. 40.

Action of Hydrogen Dioxide

Hydrogen dioxide readily **yields oxygen** to all oxidizable substances. In contact with blood, pus and other organic fluids it gives off oxygen so rapidly that it effervesces. When taken internally it gives oxygen to the blood, stimulates the nervous system, and increases urinary secretion. In the blood the oxygen set free may cause the formation of emboli and lead to serious consequences; and in several instances hemiplegia is said to have been observed, apparently from embolism of the cerebral arteries. The different organs and tissues have been found to vary considerably in their power of causing the catalytic decomposition of the dioxide, the red corpuscles of the blood and the liver cells being the most active, and it is believed that this action of the tissue cells is closely associated with the presence of nucleo-proteids, and not with ferment action, as formerly held. It is a valuable **deodorant,** and it is a non-poisonous and powerful antiseptic when diluted with two volumes of water. It decomposes pus and probably destroys the microbes of suppuration. Its antiseptic activity is of comparatively short duration, however, ending when all the oxygen is liberated.

Therapeutics of Hydrogen Dioxide

Hydrogen dioxide seems to have a favorable action in some forms of dyspepsia, and to improve digestion. It is excellent as a mouth wash in pyorrhœa or when the tongue is foul. In diphtheria it is useful as a cleansing agent and for absorbing false membranes, but it should be used with glass or hard rubber instruments. Some commercial preparations are very acid, and therefore too irritating for this purpose. This acidity may be neutralized by adding twice its quantity of lime water. It will check bleeding, but from small vessels only. It is of **great value in cleansing wounds,** ulcers and fistulous tracts, and for surgical dressings; the cessation of frothing indicates the destruction of pus. But the converse of this is not true for it will froth with perfectly normal blood. It should not be injected into a suppurating cavity unless there is a free outlet for the escape of the gas which is formed. Otherwise it might extend into the tissues and thus widen the area of infection. Because its action is temporary, ending when its oxygen is liberated, it cannot replace other antiseptics as a permanent dressing. Its most popular use is for bleaching the hair, and in hirsuties it has been found to retard the growth of hair. It is employed to a considerable extent as an injection in gonorrhœa on account of its activity in destroying the gonococcus and arresting the formation of pus. It is also useful in the treatment of leucorrhœa, otorrhœa, ozæna, tonsillitis, chancre, etc., and has proved of service as an irrigating agent in ulcerative blepharitis, purulent conjunctivitis, granular conjunctivitis, and other eye affections. A useful application of the dioxide is in the treatment of gunpowder burns, in which it is stated to absolutely remove the black stain which ordinarily remains permanently. It should be applied on the first or second day after the burn, and in such a way that it may get thoroughly into the center of each pigment spot. It is necessary to prick each point well open, when the bubbling resulting from the use of the dioxide will remove the inorganic remains of the powder. In instances of persistent vomiting repeated sips of a weak solution sometimes prove efficient. The claims that have been brought forward for the utility of hydrogen dioxide in adynamic fevers, epilepsy, diabetes, uræmia and other grave constitutional states have never been substantiated. Its use by hypodermatic injection is attended with special risk, on account of

the liability to the formation of emboli, which may either occlude the cerebral arteries or, lodging in the lungs, produce fatal asphyxia.

SULPHUR

For the Preparations of Sulphur *see* p. 40.

Action of Sulphur

External.—Sulphur is itself entirely inert, and whatever effects it has upon the system, whether internal or external, are due to the agency of sulphides resulting from solution in the secretions and of hydrosulphuric acid or hydrogen sulphide. The sulphides, being weak salts, readily yield themselves to the formation of the free acid. Although they themselves no doubt have some irritant action, in addition to that of the latter, hydrogen sulphide differs from them in being an acid with extremely marked irritant properties, and also in being a gas (sulphuretted hydrogen). It is a very powerful poison, which even in small amount is destructive to most forms of life. Its toxic effects on the system are due in part to its local irritation and in part to direct action on the brain and medulla. When inhaled in concentrated form it produces death almost instantly, and a very dilute vapor of it induces irritation of the eyes, nose and throat and a reflex increase in the secretion of tears, saliva and mucus. Upon the skin and mucous membranes sulphur has a stimulant, irritant effect and also a **parasiticidal** and **antiseptic** action. The conversion of free sulphur into sulphides is ordinarily a somewhat slow process, and as it can exert its influence only in proportion to the extent to which such conversion takes place, the **irritation** produced by it is apt to be **mild and prolonged.** This, it has been pointed out, is the secret of its therapeutic success. Applied to skin already inflamed, however, it is apt to act as a severe irritant, and to raw surfaces, such as wounds and ulcers, as a powerful caustic. Absorption may take place from the cutaneous surface, as well as the alimentary canal.

Internal.—When sulphur is taken by the mouth, the larger portion passes without change through the alimentary canal, and is so discharged in the fæces. The remainder is converted by the alkaline fluids of the intestine into sulphides, which form some hydrogen sulphide, and, after being absorbed into the blood, are oxidized

rapidly and excreted principally by the urine, as sulphates and in organic combination. A small amount of the converted sulphur is excreted by the lungs, in consequence of which the characteristic odor of hydrogen sulphide may be imparted to the breath. The sulphur compounds, by reason of their irritant effect, act locally upon the intestine, causing increased peristalsis and **mild purgation,** with soft stools and but little griping. They also have an **antiseptic action in the intestines.** Under large doses of sulphur the symptoms of intestinal irritation may be more severe than those mentioned, the evacuations assuming a bloody character. The drug has a slight **diaphoretic** action, the cutaneous secretions being stimulated to some extent during its elimination. Hydrogen sulphide is excreted in minute amount by the skin, so that silver articles about the persons of those taking sulphur may be discolored, and also in the milk of nursing women. When injected intravenously in mammals the sulphides induce violent convulsions, which are apparently of cerebral origin, since it has been shown that they do not occur in the hind limbs after section of the spinal cord. Their action on the blood is to reduce the oxyhæmoglobin and so diminish the processes of oxidation, while at the same time there is formed a compound known as sulpho-methæmoglobin or as sulpho-hæmoglobin, which is considered more nearly related to methæmoglobin than to hæmoglobin. The blood changes were formerly supposed to be the cause of death in poisoning, but it is now known that this is owing to direct action on the central nervous system. The respiration, which is at first accelerated, later becomes dyspnœic and finally ceases; the fatal result being due to this, together with the paralysis of the vaso-motor center. The heart is apparently affected only indirectly through the failure of respiration and the fall of blood-pressure.

Therapeutics of Sulphur

External.—Inunction with sulphur has always been considered the typical **remedy for scabies,** but at the present time balsam of Peru, which makes an efficient and much more agreeable application, is used to a considerable extent in its stead. The sulphur treatment should be inaugurated with a warm bath lasting about twenty minutes, after which the patient should be scrubbed all over, with the exception of the head and face, with soft soap for the purpose of

breaking open the furrows and exposing the acari or itch-insects. Next, the surface should be rinsed with clean water and dried, and then sulphur ointment should be thoroughly rubbed in with friction. The official ointment in full strength sometimes gives rise to an erythematous or papular, eczematous or pustular, eruption, and it is therefore generally well to dilute it. The patient should then go to bed, sleeping in flannel, and the next morning should wash himself clean and put on clean underclothing. One such application is generally sufficient to effect a cure, but it may be repeated once or twice. In order to prevent re-infection by the parasite, the bed linen and the clothing previously worn should either be destroyed or disinfected by baking or thorough boiling. Sulphur is also employed for pediculosis and the various forms of tinea, as well as chronic acne rosacea, eczema, psoriasis, and other skin diseases. Lotions of sulphurated potassa as well as of precipitated sulphur are used for these purposes. In acne of the face it should be used with caution, especially if the sebaceous follicles are in a patulous condition, as the sulphur, getting into their openings, is liable to cause black points. Associated with live steam, the fumes of burning sulphur may be relied upon to disinfect rooms, ships, etc. Moisture is essential for the success of the process.

Internal.—The continued use of small doses of sulphur may prove useful in such affections as acne, sycosis, psoriasis and chronic eczema, and especially when the upper layer of the skin and the glands are affected, as well as loss of hair and diseased conditions of the nails. It is a very good **laxative,** especially for children, and washed sulphur is one of the ingredients of the popular compound glycyrrhiza powder (*see* Senna, p. 660). On account of its lack of griping and the softness of the stools it causes, sulphur is very useful in hæmorrhoids, fistula and other rectal affections, and as a laxative after operations upon the pelvic organs. It is also thought to be of service in disordered conditions of the liver, for which the various mineral waters containing sulphur and its salts may likewise prove beneficial. Such waters, as for instance those of Richfield Springs, are useful for chronic rheumatism, as well as for chronic sore throat, bronchitis, etc., especially associated with digestive difficulties or a gouty or rheumatic diathesis, and for lead poisoning and various skin diseases, including the late secondary eruptions of syphilis. They are used both internally and in baths.

EXSICCATED SODIUM SULPHITE AND SODIUM THIOSULPHATE

For the Preparations of Exsiccated Sodium Sulphide and Sodium Thiosulphate *see* p. 64.

Action of Exsiccated Sodium Sulphite and Sodium Thiosulphate

These salts tend to **arrest putrefaction** and certain forms of fermentation, being moderately powerful antiseptics for the reason that they withdraw oxygen from organic matter in order to be oxidized to sulphates. As they are slowly absorbed from the alimentary canal, and a portion is changed to the harmless sulphate before reaching the blood, much larger quantities are required by the mouth than by subcutaneous injection. Large doses of sulphite have been taken without the production of toxic symptoms, but most preparations contain a considerable amount of sulphate. In some instances comparatively small quantities have given rise to gastro-intestinal irritation. As it has been found that even small doses, when given daily to animals, cause hæmorrhages in different parts of the body, the use of these salts for the purpose of preserving wines, meats, etc., should be condemned.

Therapeutics of Exsiccated Sodium Sulphite and Sodium Thiosulphate

Their therapeutic application is of somewhat limited range. Sodium sulphite, in the form of a lotion (1 to 8) is of service in aphthous sore mouth, and has also been locally used for various parasitic skin diseases. It may be given with advantage in some forms of gastric fermentation, and is especially useful in yeasty vomiting, where the sulphurous acid liberated from the salt in the stomach by the acid of the yeasty matter has the effect of destroying the microscopic fungi present (*sarcina ventriculi* and *torula cerevisiæ*). Atomized solutions of exsiccated sodium sulphite or thiosulphate may be inhaled in gangrene of the lung, fœtid bronchitis, etc. Locally applied, in a solution of 1 to 16, the thiosulphate is useful in poisoning from *Rhus toxicodendron* and in pruritus from other causes, and in double this strength for various parasitic diseases of the skin especially for pityriasis versicolor.

CRUDE CALCIUM SULPHIDE

For the Preparation of Crude Calcium Sulphide *see* p. 41.

Action of Crude Calcium Sulphide

External.—This form of sulphur is irritant, and a powerful **parasiticide.**

Internal.—In small doses it may cause a sensation of warmth at the epigastrium and also have a slight laxative effect; in large doses, excites gastro-enteritis. It is believed to have a special influence in preventing or limiting suppuration. The action of the corresponding potash salt, sulphurated potassa, is the same.

Therapeutics of Crude Calcium Sulphide

External.—Scabies may be cured by an ointment made with crude calcium sulphide, but Vleminckx's solution, which is made by boiling 165 parts of freshly slacked lime with 250 parts of sublimed sulphur, in water sufficient to make 1000 parts, and the active agent of which is calcium pentasulphide, is sometimes preferred to an ointment. It should be applied on a piece of lint.

Internal.—In order to obtain the effects of calcium sulphide on the process of suppuration the dose should be repeated at very frequent intervals. It is useful in the prevention and treatment of boils, carbuncles, abscesses, etc. It has also been used with advantage in acne, eczema, chronic conjunctivitis and ulcers in ill-nourished children, the suppuration of tuberculous glands, and acute tonsillitis, especially in strumous patients. The natural sulphide waters, such as those of the Blue Lick Springs of Kentucky, which are said to be almost identical with the well known Harrowgate water of England, are beneficial in habitual constipation from deficient intestinal secretion, and in obesity, engorgement of the pelvic viscera in women, and hæmorrhoids in both sexes, when dependent upon sluggish portal circulation. Their prolonged use has also been attended with good effects in glandular affections, but if given at all in anæmic subjects, should be associated with suitable tonic treatment.

CHARCOAL

For the Preparations of Charcoal *see* p. 48.

Action of Charcoal

External.—Charcoal is an oxidizing agent and a **deodorant.** Owing to its porous character, it is an active absorbent of gases, which

tion is sometimes increased. Research has shown that thymol is excreted in the urine in combination with sulphuric and glycuronic acids, partly unchanged and partly oxidized to thymol-hydroquinone.

Therapeutics of Oil of Thyme

The chief use of oil of thyme is as a source of thymol. As an antiseptic surgical dressing and in dermatology the latter has been used in solution and as gauze and ointment. One objection to its employment is that its odor is likely to attract house flies. Thymol is quite an efficient antiparasitic, and a solution in alcohol (1 to 15) may be employed in ringworm and pityriasis versicolor. An ointment (1 to 50) has proved of service in psoriasis, eczema, acne, alopecia circumscripta, and other skin diseases. A glycerite (1 to 200) makes a good mouth-wash. A solution has sometimes been used by inhalation with advantage in bronchitis, laryngitis and whooping-cough and as a disinfectant in diphtheria, phthisis and gangrene of the lung. Thymol solutions are useful injections in gonorrhœa and vesical catarrh. In gastric and intestinal catarrh it often acts favorably by arresting fermentation and stimulating digestion. In large doses (1 gm.; 15 gr.) it is an efficient **anthelmintic for the hook worm** (*Uncinaria americana*). On account of the danger of toxic effects, the patient should be warned not to take any solvent of thymol, such as alcohol, ether, chloroform, glycerin, oils, etc., after its administration. A purgative, preferably magnesium sulphate, must be administered at eight o'clock of the evening before commencing treatment. At six the next morning 1 gm. (15 gr.) is given, two hours later the second dose is administered and at ten o'clock of the same morning the purgative is repeated, or in its place senna or calomel may be preferred. A child requires one-half of this dose while an adult may need double the quantity given above. This course of treatment must be repeated in a week. The diet should not contain too much fat or alkalies, and but little water should be taken. Thymol may be given in capsules, wafers or gelatin-coated pills; never in solution. The poisonous symptoms of the drug resemble those caused by phenol. Should these appear the thymol must be stopped, and the bowels promptly evacuated. Thymol, both alone and in combination with gallic acid, is reported to have been used successfully in some instances of chyluria of filarious origin. It has been recommended in solution

as an irrigation in amœbic colitis. It is of no practical value as an antipyretic, as the doses required to affect the temperature in fevers are so large as to be extremely apt to cause dangerous depression of the vital powers.

THYMOL IODIDE

For the Preparations of Thymol Iodide *see* p. 108.

Action of Thymol Iodide

Thymol iodide is **non-irritant** and in its general local action resembles phenol rather than iodoform. It is, however, less desiccant than the latter, but possesses the advantage of being practically odorless. It is claimed to be non-toxic, but it is possible for its prolonged use to give rise to chronic iodine poisoning. It has been demonstrated to have no influence upon the lower organisms, and is not, therefore, directly antiseptic. In regard to its elimination, very little is known, but it would seem to be partially decomposed in the system. Iodine has been found present in the urine of animals to which it was given in considerable quantities, but no traces of thymol have been detected.

Therapeutics of Thymol Iodide

Thymol iodide has proved in many respects a very useful **substitute for iodoform.** In surgery when dusted upon serous membranes, however, it tends to prevent their adhesion, but in the treatment of wounds and sores it is contra-indicated when secretion is free. It is used for the same purpose as iodoform in cutaneous affections, such as lupus, psoriasis and eczema, in syphilitic lesions, and in a great variety of diseased conditions of the mucous membranes, and is very efficacious in the treatment of burns. It is employed as a powder and in flexible collodion, as a solution in oil or ether, and as an ointment made with hydrous wool fat or petrolatum. Heat should not be used in dispensing it, as the iodine in its composition is readily set free; and it should not be mixed with alkalies, metallic oxides, or starch.

METHYLTHIONINE CHLORIDE

For the Preparation of Methylthionine Chloride *see* p. 101.

Action and Therapeutics of Methylthionine Chloride

This remedy, also known as methylene blue (not methyl blue), has been introduced into medicine as an antiseptic, but is of little use as

such. It also possesses hypnotic, **anodyne** and diuretic properties. After oral administration it has been found in the bile. It imparts a blue or bluish-green color to the urine, and may be employed to test the rate of excretion of urine by the kidneys.

It has been used for alcoholic neuritis and the pains of locomotor ataxia. It would seem to be a remedy of some value for quieting patients suffering from incurable mental disease in which excitement is a prominent symptom. In a number of instances of mania and paretic dementia it produced a **calmative** effect which did not resemble the action of hypnotic drugs, but seemed rather a natural quietude. When given internally, it may cause gonococci to rapidly disappear from the urine in specific urethritis. It produces irritation at the neck of the bladder, which about 2 gm. (30 gr.) of powdered myristica is said to relieve. As to its effects upon inoperable neoplasms when injected into them clinical reports differ widely, but the present opinion is that they are unimportant.

BALSAM OF PERU

For the Preparations of Balsam of Peru *see* p. 194.

Action of Balsam of Peru

It is a **general stimulant,** and its external application is occasionally followed by an erythematous, urticarial, or eczematous eruption. This is more likely to be observed from the use of the artificial balsam, which has practically excluded the genuine from the market. It has some **antiseptic** properties, and is efficient in the destruction of animal and vegetable parasites. It also allays irritation of the skin and mucous membranes. By its stimulating action on wounds it facilitates the repair of tissue. Internally it is **stomachic, carminative and expectorant.** In large doses it may act as a gastro-intestinal irritant, inducing vomiting and purging, but in smaller quantities causes redness of the skin and stimulates the circulation. It is excreted by the skin, kidneys and respiratory mucous membrane, and during its elimination is believed to stimulate and have a tendency to disinfect the secretions from these parts.

Therapeutics of Balsam of Peru

External.—Balsam of Peru has long been used, either pure or diluted as an application to wounds, compound fractures, and indolent ulcers. As a **stimulating dressing** for sluggish granulations

a 5 to 10 per cent. solution in castor oil is frequently employed and with great benefit. This solution, saturating a number of layers of gauze, over which oiled silk or a starch bandage is applied, is very efficient in maintaining drainage in wounds, abscesses, burns, etc. It is also an excellent deodorant, and is said to conceal to a large extent the disagreeable odor of iodoform when it is used in connection with it. It is one of the best known remedies for pruritus vulvæ and other varieties of pruritus, especially the senile, and is generally applied pure in these conditions. It is successful in removing leucoplakia, or local epithelial thickening of the mucous membranes, and is of service in chronic inflammatory diseases of the skin, especially eczema. One of its principal uses is as a parasiticide in ring-worm, pediculosis, and scabies, and for this purpose an ointment consisting of balsam of Peru, 20; olive oil, 50; petrolatum, 100, may be employed. For **scabies** it should be employed in the same manner as sulphur ointment (*see* p. 328) with which it may be used in combination. It is as efficient as the latter, killing the eggs as well as the insect, and is at the same time much more agreeable to the patient.

Internal.—It is a useful remedy in chronic bronchitis and bronchorrhœa, as well as at times in chronic intestinal catarrh and dysentery. It has been claimed that by the use, in phthisis, of subcutaneous and intravenous injections of balsam of Peru, or its chief constituent cinnamic acid, a specific inflammation of the diseased areas might be set up, which would subsequently result in cicatrization of the tuberculous nodules, but this has not been received with favor, as no conclusive evidence has been presented that the alleged effects are produced. At the same time, when given by the mouth or by inhalation, its **expectorant** action may no doubt sometimes be of service in this disease.

The Anthelmintics

(1) For Various Species of Tape-worm (Tæniæ).

ASPIDIUM

For the Preparations of Aspidium *see* p. 238.

Action of Aspidium

When given in ordinary doses this drug generally passes through the system, even when some absorption takes place, without giving

rise to any symptoms, though there may be slight intestinal disturbance. When large quantities are taken, or if for any reason an unusual amount of its active constituents become absorbed, alarming and even fatal results may be observed. Instances of poisoning have been reported, presumably not due to an excessive dose, but to the fact that castor oil was administered at the same time, with the effect of notably increasing the absorption of filicic acid. The toxic symptoms consist of nausea, vomiting, purging, intense abdominal pain, muscular weakness, cramps in the extremities, tremors, increased reflexes, confusion of ideas, and somnolence deepening into coma, with collapse. The secretion of urine is apt to be diminished. In many patients disturbances of vision, or even complete loss of sight, or deafness without loss of vision, occur, without any distinct ophthalmoscopic appearances, and sometimes there are convulsions, which may be tetanic in character and accompanied with opisthotonos. In a considerable proportion of instances icterus is present, probably resulting from duodenal catarrh, though it may possibly be due to destruction of the red corpuscles of the blood. After death the gastro-intestinal mucous membrane is found to be congested, swollen, and sometimes dotted with ecchymoses, and degeneration of the nerve-fibers is also observed. The treatment recommended for poisoning is the administration of magnesium sulphate by the mouth and, if severe, ammonia by subcutaneous injection.

Therapeutics of Aspidium

Aspidium acts as a direct poison to **tape-worms**, and is one of the most certain of all remedies for these entozoa. It is also used against the *Uncinaria americana*, and the ethereal extract has proved of service in the treatment of cysticercus disease, especially when the lesions were situated in the subcutaneous or muscular tissues. The drug is considered more successful against the *Tænia solium* (the armed variety of tape-worm), and the *Bothriocephalus latus*, for which it is especially efficient, than against the *Tænia medio-canellata*. For a day before taking the medicine the patient should use a liquid diet, such as milk or soups. On the following morning, the bowels having been previously evacuated, he should take, fasting, a full dose of the oleoresin, which may be administered in pills or capsules or in a draught made up with mucilage and flavored with ginger,

cinnamon or peppermint. In the middle of the day the patient may eat a full meal, and in the evening should take a brisk cathartic. Inasmuch as the remedy is directed against the worm the size of the dose is not regulated by the age of the patient. It must be remembered that all anthelmintics, pepo excepted, are poisonous and the largest dose which is safe is the one to be chosen. Castor oil or other oils should not be used, on account of the danger of increasing the absorption of filicic acid, and thus causing toxic symptoms. The head of the tape-worm should be carefully searched for in the stools.

POMEGRANATE

For the Preparations of Pomegranate *see* p. 238.

Action of Pomegranate

On account of the large amount of tannic acid which it contains, pomegranate is apt to disturb the stomach and cause nausea and vomiting, to occasion flatulence and intestinal pain, and sometimes, but not always, to act freely on the bowels. Other symptoms produced by large doses of the drug are general weakness, muscular tremors and cramps, particularly in the leg muscles, hebetude, vertigo, and mental confusion, without loss of consciousness. The urine is increased in quantity. Like aspidium, pomegranate frequently causes disturbances of vision and diplopia; mydriasis and amaurosis have been observed.

Pelletierine tannate, the mixture of four alkaloids of pomegranate, as tannates, in sufficient quantity, causes paralysis of the motor nerves, without affecting sensation or muscular contractility. It has been proved experimentally to have a **specific toxic action on tape-worms,** a solution of one part in 10,000 causing their death in ten minutes, while other intestinal worms are unaffected by stronger solutions. For practical purposes pelletierine tannate is the least dangerous as well as the best form of the drug, as its insolubility no doubt prevents its rapid absorption and ensures its prolonged contact with the worm.

Therapeutics of Pomegranate

Pomegranate is exceedingly unpalatable and is so liable to cause emesis that the purpose of the drug may be thus defeated. When retained by the stomach it is usually an efficient remedy for **tape-worm.** It is best administered in decoction (1 to 5; dose, 60 mils;

2 fl. oz.), and of this several dŏses may be taken, fasting, at intervals of an hour. It should be preceded by a brisk cathartic, and, if the remedy does not have a purgative effect, be followed by another. If the patient is unable to take the decoction in this way it is recommended that the requisite quantity should be evaporated in a water-bath to a pilular consistency and administered in capsules, preceded and followed by a cathartic. On account of its powerful astringent properties pomegranate is sometimes employed for the same purposes as tannic acid and other astringent remedies. Internally pomegranate has been advantageously employed in the diarrhœa and dysentery of hot climates, and also in Ménière's disease.

Pelletierine tannate is one of the most reliable of tæniafuges, and is decidedly preferable to pomegranate itself on account of the facility with which it can be taken and its freedom from nauseating properties. It is usually given in capsules, and, like pomegranate, should be preceded and followed by a purgative. It should be administered with great caution to children. It has been found successful in affording relief in paralysis of the third and sixth nerves.

PEPO

For the Preparations of Pepo *see* p. 239.

Action and Therapeutics of Pepo

Pepo is one of the most efficient and at the same time harmless tæniafuges. It has no purgative action or other known physiological effects.

It is employed exclusively as an anthelmintic for the **tape-worm**, and is generally given in the form of emulsion. An emulsion is made of 30 gm. (1 oz.) of the fresh seed powdered in a mortar, with 250 mils (8 fl. oz.) of water, until the husks are thoroughly loosened. The mixture is then strained, and the whole amount taken fasting. By some it is maintained, however, that the effect is better if the husks are retained in the emulsion or the seeds may be beaten into a paste with milk and sugar. Some are in the habit of associating the oleoresin of aspidium with pepo in the treatment of tape-worm and others of adding pomegranate to this combination.

(2) For Round-worms (Ascaris Lumbricoides).

SANTONIN

For the Preparations of Santonin *see* p. 240.

Action of Santonin

Santonin is a very efficient **vermifuge** for the *Ascaris lumbricoides*. Its mode of action is not definitely understood. It has been supposed to have a specific action upon this worm; but experiment outside the body has demonstrated that it is not directly fatal to these parasites, and the most satisfactory explanation of the anthelmintic action of the drug is that it renders the small intestine so disagreeable a habitat for them that they are driven down into the lower bowel, from which they are dislodged by the purgative medicine employed in connection with the santonin. On the human system santonin has distinct effects, resulting from its absorption, the most characteristic of which is a **derangement of color vision.** There is also a **discoloration of the urine** (a saffron or brownish color when the latter is acid, and a purplish red when it is alkaline), similar to that resulting from chrysaphanic acid (*see* p. 563). The fæces, likewise, sometimes assume a deep yellow color. Ordinarily a portion of the santonin is dissolved by the alkalies in the stomach, with which it forms soluble and absorbable santoninates, while the remainder passes into the intestine; but under special circumstances the greater part of the drug may be absorbed in the stomach and cause general intoxication of the system. Even small doses give rise to xanthopsia, or yellow vision. In this disorder white light has at first a violet hue, usually lasting but a short time, and then a greenish-yellow color, which tints the entire field of vision; and the same has occasionally been observed with amyl nitrite. The power of seeing in dim light is also stated to be lessened. These effects have been demonstrated to be peripheral, and consequently are not due to discoloration of the media of the eye. The symptoms produced by large doses of santonin are as follows: Twitching of the muscles of the head, often beginning on one side; followed by rolling of the eyes, grinding of the teeth, flexion and extension of the neck and rotation of the head from side to side, later by characteristic **epileptiform convulsions,** in which the animal is first thrown into opisthotonos and then into clonic spasms of the limbs and trunk. These are interrupted by intervals of repose, during which a momentary contraction of all the muscles of the body may take place. During the convulsive seizures the respiration is irregular and insufficient, and in fatal instances it fails to return after the convulsion passes off, and death follows from asphyxia. Aphasia, in man, has occasionally been noted,

and some mental confusion, as well as nausea and vomiting, may result from doses too small to cause convulsions. The epileptiform convulsions are believed to be due principally to stimulation of the cortex and the brief contractions in the intervals of repose to increased activity of the parts between the cerebral peduncles and the medulla. That the medullary centers are comparatively little affected seems to be shown by the fact that the respiration, interfered with during the spasms, usually returns to its ordinary rate and strength during the intervals. The circulation is found to be deranged only by the asphyxia, while the heart continues to beat long after the respiration has ceased.

Therapeutics of Santonin

Santonin is now almost universally used as a remedy for **round-worms.** Upon tape-worms and the *Oxyuris vermicularis* it has very little effect. In addition to its efficiency, it is especially serviceable on account of the ease with which it may be administered to children. Owing to its insolubility in water its taste is only slightly bitter. It is generally most effective when exhibited three times a day until six doses have been taken, when a cathartic is to be administered. Lozenges, which are found in the pharmacies, containing it are not to be commended, as they often may fail to dissolve.

TOXICOLOGY

Symptoms.—A number of deaths from santonin are on record, and in a few exceptional instances serious or even fatal effects have been caused by quite small doses. Children appear to be peculiarly susceptible to the ill effects of santonin. The danger of poisoning is lessened if the drug is given in castor oil. In instances of poisoning by santonin, in addition to the nervous phenomena described, there is, generally, marked pallor and coldness of the surface, with a blue tint around the eyes or involving the whole face, dilatation of the pupils, and sweating, which is sometimes very profuse. The temperature is reduced, and there may be gastric or intestinal pain.

Treatment.—Evacuation of the stomach and bowels. Ammonia, or strychnine sulphate hypodermatically and artificial respiration may be required. The convulsions may be controlled by ether or chloroform.

SPIGELIA

For the Preparations of Spigelia *see* p. 240.

Action and Therapeutics of Spigelia

Spigelia is an efficient anthelmintic against the **round-worm,** and appears to act very much in the same way as santonin. Given in

large doses, especially in the case of children, it may cause flushing and dryness of the skin, frequently associated with œdematous swelling of the face, and such cerebral symptoms as vertigo, dimness of vision, spasm of the facial muscles, stupor and even convulsions. Experiment has shown that toxic doses slow and weaken the heart's action and depress the motor areas of the spinal cord, and the respiratory center.

Spigelia has long been a popular and reliable remedy for lumbricoid worms. It is much less liable to give rise to symptoms of narcotic poisoning when it is given in combination with a cathartic, and senna is usually employed for this purpose. Santonin is sometimes prescribed in connection with the fluidextracts of spigelia and of senna. The remedy, with a cathartic, should be repeated every four hours until a purgative effect is produced.

OIL OF CHENOPODIUM

For the Preparation of Oil of Chenopodium *see* p. 241.

Action and Therapeutics of Oil of Chenopodium

Oil of Chenopodium is one of the most efficient anthelmintics, particularly against *Ascarides* and acts as a stimulant to the circulation and nervous system. It is said to increase the cardiac rate and to promote the secretions of the skin, bronchi and kidneys.

It is used almost exclusively as an anthelmintic and may be given on sugar, in capsules, or in emulsion, repeated three times a day, before meals, for two days, when a cathartic should be ordered. It is, no doubt, the safest vermifuge when the mucous membrane is inflamed, as it appears to have a beneficial action upon the intestinal irritation.

(3) For Thread- or Pin-worms (Oxyuris Vermicularis).

Calumba (*see* p. 630), Quassia (*see* p. 632) and Nutgall (*see* p. 508) are commonly employed.

(4) For Hook-worms (Uncinaria americana).

Generally Thymol (*see* p. 334) is efficient.

The Antiparasitics

(1) For Vegetable Cutaneous Parasites.

CHRYSAROBIN

For the Preparations of Chrysarobin *see* p. 241.

Action of Chrysarobin

External.—Chrysarobin has a deep and strong **local irritant action.** Applied to the skin it induces itching, redness and swelling, and in some instances follicular or furuncular dermatitis. It stains the skin and clothing a dark yellowish-brown or purple color, which may, however, be removed by a weak solution of chlorinated lime, provided no soap or alkali has been used. Its application to the skin has been known to cause slight albuminuria. A certain amount is absorbed from the skin, and if it is applied over an extended area it may give rise to constitutional symptoms. It is also irritant to mucous membranes. Small quantities will excite conjunctivitis, and the inflammation set up by it is sometimes so severe as to result in corneal ulceration. In a dilute form chrysarobin acts as a reducing agent, taking oxygen from the tissues and promoting the growth of normal epithelium. The drug is a **vegetable parasiticide,** being poisonous to organisms of a fungous type.

Internal.—Chrysarobin is a decided **gastro-intestinal irritant.** It produces copious, watery, brownish-colored stools, with repeated vomiting, but not much nausea. The greater part of it passes through the tissues unchanged; the remainder is absorbed and undergoes oxidation to chrysaphanic acid. The portion absorbed is excreted in the urine, to which it imparts a yellow color, which turns to red upon the addition of alkalies.

Therapeutics of Chrysarobin

It is largely used locally for its stimulating action in chronic inflammatory diseases of the skin, and also for its curative effect upon vegetable parasitic eruptions, such as the various forms of tinea. In the former class it is of service in the treatment of eczema, acne rosacea, lupus vulgaris, and especially **psoriasis,** in which it is considered by many the best known external remedy. In psoriasis a preliminary treatment of the patient with his own blood serum (autoserum), administered intravenously, will lessen the amount of chrysarobin necessary to complete the cure. It should always be used with caution, as it is liable to set up dermatitis of the surrounding integument. It is recommended that the official ointment should be considerably diluted before application, on account of the danger of exciting too much inflammatory reaction. The best way to use it is by dis-

solving 1 part in 7 parts of chloroform, and stirring an equal quantity of petrolatum into the solution. Applied by means of a brush, this can be painted with accuracy on the parts desired, and is less liable to stain. Chrysarobin should rarely or never be used on the face, because of the danger of inducing œdema of the eyelids or conjunctivitis. For the same reason it should also be used with great caution on the scalp. Alopecia circumscripta and ringworm of the scalp, however, have both been very successfully treated by means of it. It is affirmed by some that the action of this drug upon certain cutaneous affections is not only local but also constitutional, the opinion being expressed that, absorbed from one part of the skin, it is capable of exerting a beneficial influence upon other parts of the skin to which it has not been directly applied. However this may be, there seems to be little question that in many of the conditions in which chrysarobin has been employed equally good results may be obtained by other remedies which are not so irritating and so liable to give rise to unpleasant effects.

(2) **For Pediculi.**

STAPHISAGRIA

For the Preparations of Staphisagria *see* p. 241.

Action and Therapeutics of Staphisagria

It is a **parasiticide** and is irritating to the skin, producing erythematous inflammation. Taken internally it is a gastro-intestinal irritant and a depressant to the motor nerves, heart and respiration, causing death by asphyxia. The symptoms resemble those of poisoning by aconite, excepting that tingling in the face is not marked, and it belongs to the same botanical family.

It is principally used in **pediculosis,** and may be applied in the form of ointment (Staphisagria, 4; yellow wax, 2; benzoinated lard, 17). Sometimes the dry powder is dusted over the affected surface, but generally the fluidextract is used in combination with diluted acetic acid or with ether. Applications of this character are also efficient in **scabies.** In using the latter preparation externally, care should be taken to apply it only upon the unbroken skin. An instance is recorded in which its too free use upon a child was attended with fatal results.

The Antiperiodics

CINCHONA

For the Preparations of Cinchona and its Alkaloids *see* p. 150.

Action of Cinchona and its Alkaloids

Cinchona owes its effects on the organism almost entirely to its contained quinine. The bark, however, is more of a gastric irritant than quinine and is also a decided astringent, while on account of its bulk its active principles are more slowly absorbed. Large doses of it have been known to cause an apparently well-marked febrile paroxysm, beginning with chill and terminating with slight perspiration, but quinine has been found incapable of exciting such symptoms in a healthy individual. Quinine salts have the same action as quinine itself. The action of the drug may be most conveniently studied from the effects of quinine sulphate, which from its general use is commonly known as quinine.

External.—Quinine has little or no influence upon normal skin, but is distinctly irritant to mucous membranes and raw surfaces. It is recognized as a protoplasmic poison, its action affecting most forms of living matter, and generally consisting in a transient augmentation of activity which is followed by depression and death. Quinine solutions, therefore, have considerable **antiseptic** power, while the lactic, butyric and alcoholic fermentations are either retarded or completely prevented. It appears to have a selective action, however, since it has been found devoid of influence upon some of the lower forms, as, for instance, the common mould penicillium, which grows freely in its solutions. It has been found that while the gastric and pancreatic ferments are rendered less active by the addition of quinine, the drug has practically no effect on the action of ptyalin and diastase. In brief, from the results of careful experimental research it has been concluded that quinine hinders some, if not all, of the processes which normally occur in living matter, and also that this action is not confined to the intact protoplasm, but extends to the ferments. Various cells may show asymmetric cell-division, as the ova for example, under the action of quinine. The amœbæ are influenced by quinine. They cease their characteristic movements and die. In regard to the amount of

its antiseptic power, most observers have found this equal to or greater than that of phenol and of salicylic acid, but considerably less than the salts of mercury and silver. About 0.2 per cent. solutions are antiseptic; this strength preventing acetic and butyric fermentations and the decomposition of albuminous substances. Some bacilli are quite susceptible to its influence; others, especially anthrax spores and the spirillum of relapsing fever, are found to be more refractory.

Internal.—*Alimentary Canal.*—Its chief action here is that of a **vegetable bitter,** marked and prolonged. The gustatory and gastric nerves are stimulated reflexly, inducing more or less increase in the salivary and gastric secretions. It is, then, a stomachic tonic, promoting appetite and digestion. It is a question how far its antizymotic action, which if unrestrained would exert some slight retarding influence on the gastric juice, and so tend to interfere with digestion and absorption, is really operative; but it seems probable that this is more than counterbalanced by the reflex effects on the stomach and the mild stimulation of the gastric mucous membrane. In large doses it may cause nausea and vomiting. On the intestine, quinine has no well-marked effect except it be given in large amount, when it acts as an irritant and may cause diarrhœa, which in exceptional instances may be characterized by bloody stools. The preparations of cinchona bark, owing to the presence of tannic acid, oftentimes exercise an astringent effect upon the intestinal mucous membrane, and cause constipation. When taken into the stomach quinine is dissolved by the acid gastric juice, and quinine chloride is formed. If not promptly absorbed, however, it passes into the intestine and is liable to be precipitated by the alkaline secretions, which form with it insoluble salts; so that under these circumstances a considerable portion of the quinine escapes absorption and is discharged in the fæces.

Blood.—Quinine has been shown to have a special action upon the blood, which, however, is merely an illustration of its effects on the tissues generally. (*a*) *White corpuscles.*—When a small quantity is added to a drop of blood on the warm stage of the microscope it is observed that the normal changes in form and position of the leucocytes are at once stopped, while these cells become spherical in shape, darker in color and granular, and shortly disintegrate into débris. Similar results are observed in the mesentery of the frog

when quinine is applied locally, and if the part be slightly irritated, so as to set up inflammatory action, the leucocytes do not accumulate in the tissues, as would be the fact without the application of the drug; while if the quinine is applied after such irritation has been resorted to, the outpouring of the leucocytes through the capillary walls (diapedesis) is at once arrested. The same thing occurs when quinine is injected into the circulation, and the leucocytes, which assume a spherical form, especially the polynuclear, are considerably diminished in number. While, however, these changes are due, no doubt, to the poisonous action of the drug on the white corpuscles, it has been pointed out that it would be unjustifiable to infer from such experiments that quinine, in therapeutic doses, inhibits the movements of these cells in the human body. At the same time it is unquestionably true that in man ordinary quantities of quinine, even when absorbed from the gastro-intestinal tract, have the effect of diminishing the number of leucocytes. (*b*) *Red corpuscles.*—On these it appears to have but little effect. It is true that certain observers have described an increase in size and others a destructive influence on the red corpuscles, but it has been found that this does not occur under ordinary circumstances. It should be stated, however, that one authority arrived at the conclusion that quinine has a direct effect in increasing the number of the red corpuscles. (*c*) *Other effects.*—The addition of quinine to drawn blood prevents the acid fermentation which normally takes place in it as the result of the oxidation of unknown substances at the expense of oxyhæmoglobin, which it partially reduces. That quinine exercises an inhibiting influence on the oxidizing action of the blood is shown by the fact that blood to which the drug is added fails to decolorize indigo. It therefore lessens the ozonizing power of the blood; but although the oxidizing energy of the latter is diminished, and oxygen is given off less readily, it has been found that in the body the hæmoglobin is apparently uninfluenced. It has been stated that quinine retards the coagulation of the blood.

Heart and Circulation.—It causes at first contraction of the arterioles and a quickening of the heart's action, which is followed by dilation of the vessels and a slowing and weakening of the cardiac contractions. These effects are believed to be probably due to the direct influence of the alkaloid on the muscular structure of the circulatory system, although by some, the acceleration has been

attributed to depression of the inhibitory mechanism in the heart or in the medulla. Accompanying the acceleration of the pulse there is a rise of blood-pressure, which seems to depend mainly on the vaso-constriction. It has been found that the pulse-rate in general follows the blood-pressure, but that during the fall it does not sink so rapidly and markedly as the pressure. In fatal poisoning the heart is stated to be generally very much weakened when the respiration stops, but continues to beat for some time afterwards. Quinine very frequently causes **derangement of the sense of hearing** and less commonly derangement of that of sight, which are believed to be due to vascular changes, rather than to any effect upon the brain. In the one instance there are deafness and ringing in the ears and in another diminished acuteness of vision, defective color-vision, dilatation of the pupil, contraction of the visual field, and in other instances temporary blindness. The disorders of hearing are attributed to congestion of the auditory canal and those of sight to a very marked contraction of the retinal vessels, which may even be obliterated; but why quinine should produce these opposite vascular effects in the eye and the ear still remains unexplained. The congestion of the membrana tympani has been known to result in inflammation causing permanent impairment of the hearing, and the constriction of the retinal vessels may be so severe as to produce degeneration of the ganglion cells and ascending atrophy of the optic nerve.

Respiration.—In moderate doses quinine slightly stimulates the respiration, but in large ones acts as a depressant. In exceptional instances quinine induces an asthmatic condition, characterized by a feeling of suffocation and rapid, noisy and irregular breathing.

Cerebrum.—The activity of the brain is thought to be stimulated by small doses of quinine, which even seem to exhilarate susceptible individuals. Large doses produce a sense of heaviness and fullness, with depression, confusion of ideas, hallucinations and difficulty of speech, and, in addition, there are sometimes observed giddiness or vertigo, uncertainty of gait, and slowness of the pulse. The mental depression may deepen into melancholia or even dementia, which is curable; while in some instances, instead of depression there is excitement, which may amount to mania. Collapse may follow. One effect of quinine on the cerebrum is of special interest from a therapeutic point of view, and that is the diminished appreciation

of pain, as that of neuralgia, or that associated with influenza, and is caused by it. By some the blindness and deafness resulting from large doses are thought to be probably partly of central origin.

Spinal Cord and Nerves.—Small quantities are said to have the effect of stimulating the spinal cord, which is afterwards depressed. It is stated that solutions of quinine when applied locally, even in sufficient strength to cause marked abnormalities in the muscular contraction, do not lessen the irritability of the nerve trunks, and that no satisfactory proof has been offered that the alkaloid affects the peripheral ends of the motor or sensory nerves.

Muscles.—Experiment shows that the strength of the contractions may be increased as much as six times by moderate amounts of quinine, but the muscle is much more quickly fatigued than normal muscle, so that its total work is less, this undoubtedly depending upon a direct action on the muscle-fiber. Somewhat stronger doses are found to lower the contraction from the beginning, while large quantities produce vigor. Quinine thus acts upon muscle in the same way as upon the simpler organisms, at first augmenting its energy and then weakening it.

Uterus.—There is considerable evidence to show that quinine stimulates uterine contractions when labor has already commenced. In some instances it also appears to increase the menstrual flow, but it is improbable that it is capable of exciting abortion. Its action in uterine inertia may perhaps be due in part to its action on unstriped muscle, such as it appears to have upon that of the arterioles, and in part to its effect in arousing the general nervous forces of the system. It tends to prevent post-partum hæmorrhage by causing contraction of the uterus.

Urine.—Quinine has sometimes, but not constantly, the effect of somewhat increasing the amount of urine, an action which is thought to be due to its influence upon the renal epithelium, by which it is excreted. Quinine is found in the urine within half an hour after its ingestion by the mouth, and about one-half the quantity absorbed is excreted within six hours. After this, its elimination takes place less rapidly, and traces may be discovered in the urine seventy-two hours after its ingestion.

Metabolism.—Even in very small doses quinine has a pronounced effect. In the excretion of nitrogen there is at first a slight increase probably due to destruction of the leucocytes, and then a marked

diminution, which, with large doses, may amount to 39 per cent. This is the result of the powerfully depressant action of quinine on the elimination of all the nitrogenous excretory substances, and especially urea and uric acid. In contrast to this, and somewhat contrary to what one would naturally be led to expect, is the slight influence of quinine upon the oxidation of the body; the quantity of oxygen absorbed and of carbon dioxide given off being practically unaffected by even large medicinal doses. While quinine is excreted chiefly through the kidneys, it appears to be diffused from the blood to a limited extent through various other channels, and has been detected in the tears, saliva, sweat and milk, as well as in the bile and in dropsical effusions.

Temperature.—In the normal subject quinine sometimes has the effect of reducing the body temperature to a small extent. In other instances the temperature remains entirely unaffected, while in still others it undergoes a slight rise. As a rule, it may be stated, small doses cause this slight rise, while doses considerably larger, but not sufficient to produce marked collapse, occasion an insignificant fall of temperature. In febrile conditions, however, it has a decided **antipyretic** effect, though not so marked as that of drugs of the antipyrine or acetanilid, and salicylic acid classes. The fact that this action may be produced after division of the spinal cord shows that it does not depend upon any influence exerted upon the central nervous system, and it is now accepted that the temperature-reducing property of quinine is due to the direct action of the alkaloid upon the tissues. Owing to its preventing the destruction of proteids less heat is generated, so that whatever effect quinine has in this direction it is not through heat regulation but from lessened production of heat. It is true that the excretion of carbon dioxide is generally regarded as an index of chemical changes resulting in the liberation of energy and consequently of heat; but, while, as has been seen, quinine ordinarily does not seem to affect this to any appreciable extent, it is thought extremely probable that the antipyretic action of the drug is due to its retarding the metabolism. In support of this hypothesis it has been suggested that the presence of fever poisons throws the tissues into a state of augmented activity, in which they are more susceptible to the sedative action of the drug, and that even in the normal organism a reduction of the temperature might be induced if a sufficient quantity could be taken without

exciting other symptoms. In this connection attention is called to the fact that in fever the nitrogenous decomposition is much increased, while quinine has a directly opposite effect; and it is pointed out that the diminution in the nitrogenous metabolism may also lead to an increased resistance being offered to the cause of the fever, or may lessen the poisonous products circulating in the blood. Furthermore, it is argued, the bacteria causing fever may themselves be rendered less active by the alkaloid, although this antiseptic action is probably of subordinate importance, since many of the pathogenic bacteria have been found to offer great resistance to it.

Cinchonism is the name given to the sequence of symptoms to which doses of 0.60 gm. (10 gr.), or more, of quinine are liable to give rise. The most characteristic of these are a sense of fullness in the head, tinnitus aurium, and slight deafness. From larger amounts these symptoms may be augmented, and in addition the patient may suffer from disorders of vision, sometimes amounting to blindness, and the severe cerebral disturbances which have already been mentioned. The susceptibility to the physiological effects of the drug differs very greatly in different individuals, and various idiosyncrasies as regards its influence have frequently been noted. Occasionally it is the cause of cutaneous eruptions, such as erythema, urticaria, herpes, purpura, etc., and instances have been reported in which the affection was gangrenous. As a frequent cause for eruptions, often atypical, quinine must be excluded before a final diagnosis is reached by the dermatologist. Gastro-intestinal irritation is not infrequently occasioned by comparatively small doses, and in a very few instances albuminuria and hæmaturia have resulted from it. Death from quinine is of extremely rare occurrence. Enormous doses have sometimes been taken without peril to life, and it seems probable that in these instances a large proportion of the drug passed through the system without being absorbed. Hydrobromic acid has been found in many instances to prevent the ringing in the ears or headache caused by it. The bromides may also be used for this purpose, and extract of ergot likewise is said to diminish the liability to cinchonism. In respect to their effects on the brain, morphine and quinine are regarded as antagonistic and in respect to their action on the sympathetic system, on the heart, and on the temperature, quinine and atropine. The

latter drug is said to be successful in combating the annoying cutaneous symptoms sometimes caused by quinine.

Relative Action of the Alkaloids.—The other alkaloids resemble quinine very closely in their effects on the system, but are weaker in their action. Quinidine is most like quinine, while cinchonine and cinchonidine differ from the latter in having a convulsant influence; in consequence of which the stage of stimulation in their action on the central nervous system is more marked. This tendency to produce convulsions, which are of an epileptiform character, is said to be much the more pronounced in the case of cinchonidine, which, but for its resemblance in other features to quinine, might, it is held, be classed among the convulsive poisons. The relative antipyretic effect of the alkaloids has been set down as follows: Quinine, 100; quinidine, 90; cinchonidine, 70; cinchonine, 40.

Therapeutics of Cinchona and its Alkaloids

External.—The expense of quinine renders it unavailable, as a rule, for antiseptic purposes. Quinine and urea hydrochloride in solution, hypodermatically, has an extensive use for local anæsthesia; it has even been recommended as an efficient **substitute for cocaine,** in from 0.5 to 3 per cent. solutions. The stronger solutions may, however, retard healing. In major operations it may be used, in advance of operation, to anæsthetize the field and, by inhibiting afferent conduction, to lessen shock. An attack of hay-fever, if the catarrhal irritation is confined to the nares and fauces, may in some instances be arrested by the topical application by means of a camel's-hair brush, or in the form of a spray, of a solution of quinine hydrochloride (1 to 60 of water). The bisulphate has been employed in antiseptic injections for gonorrhœa in both the male and in the female. It has been used in 0.2 per cent. solution as an irrigation of the colon in amœbic colitis and, like some of the bitters, for the destruction of thread-worms. It is a frequent constituent of some popular hair tonics and restorers.

Internal.—*Gastro-intestinal Tract.*—The preparations of cinchona are used to a large extent in digestive disturbances, especially when associated with a debilitated state of the system, and, if their administration is not maintained for too long a time, generally serve an excellent purpose. In gastric catarrh, especially of drunkards,

they may often be combined advantageously with the mineral acids. They are contra-indicated in all inflammatory states of the gastro-intestinal mucous membrane, but where the latter is relaxed and there is more or less diarrhœa without inflammation, preparations of the red bark are likely to be of great benefit; the compound tincture, is to be commended. Quinine is one of the most commonly used of all tonics, and in the small quantities required for this purpose may generally be continued for a very considerable time without causing any impairment of digestion or absorption. It is frequently given associated with iron, and is apt to be prescribed especially with the tincture of ferric chloride, the free acid in which readily dissolves it. Strychnine is also often added to combinations of quinine and iron.

Antipyretic Effect.—While quinine was formerly much as an antipyretic, at the present time, except in the case of malarial fever, it is seldom employed in this capacity, since in the comparatively rare instances where it is deemed advisable to reduce the temperature by means of drugs this can be much more efficiently accomplished by the coal-tar derivatives, such as acetphenetidin. Where for any reason it is desirable to use quinine in febrile conditions for this purpose it should be given preferably in a single dose of from 1.20 to 2.40 gm. (20 to 40 gr.) for an adult. It may be administered in tablets or capsules, suspended in milk, or in solution. For dissolving the hydrochloride only water, in sufficient quantity, is required, but in the case of the sulphate it may be necessary to add an acid. With these large doses it is advisable to give sodium bromide, in order to avoid the disagreeable tinnitus, which is likely to be set up by the drug. The diluted hydrobromic acid is an excellent solvent, and, at the same time, will relieve the ringing in the ears. In a considerable proportion of patients the antipyretic action of quinine may be relied upon, and, like the other antipyretics, it will be found most efficient at a time when the temperature has a natural tendency to fall. Usually about two hours elapse before the antipyretic effect manifests itself, and it should therefore be given at that interval before an expected decline in temperature. Quinine, it is worth noting, possesses the advantages over the coal-tar antipyretics of a more prolonged action and of exposing the patient to much less risk of collapse. It is therefore still prescribed to some extent in surgical fever.

Specific Action.—One of the most positive effects in all therapeutics is that of quinine, and to a less pronounced degree the other alkaloids of cinchona, in arresting the paroxysms of malarial fever. It is now known that this result is due to the **directly poisonous action** of the drug **upon the plasmodium malariæ,** which infests the blood and is the specific cause of the disease. Outside the body a 1 to 10,000 solution of quinine will immediately arrest the movements of the hæmatozoön, and the same thing is found to occur when the alkaloid is circulating in the blood. Here it prevents the entrance of the spores into the red-corpuscles, in which their cycle of development takes place. About three hours after the administration of quinine by the mouth it is stated that the endoglobular forms met with in tertian and quartan fever become immobile and granular, and lose their affinity for certain stains; while several hours later they may be seen deformed and segmented. Research has shown that quinine does not act equally on the parasite in all its stages; its most powerful effect being upon the forms which are just breaking into spores and upon the freely mobile organisms, while its action is much weaker upon the older segmenting bodies, and least upon the young endoglobular forms. Since it has been found that these last exist in the blood just before the paroxysm, their sporulation giving rise to the characteristic chill with its ensuing febrile reaction, quinine, on account of the inefficiency of its action upon them, will have little or no effect in counteracting the paroxysm then impending. If, however, it is given at this time it will, it is argued, be present in the blood when the spores are liberated, and since these, as has been seen, are most susceptible to its action, it will be able, if the quantity administered has been sufficiently large, to destroy them, and thus prevent the development of the new cycle. It is advisable, therefore, that the alkaloid should be given several hours before the expected paroxysm, so as to allow time for absorption. The powerful destructive action which quinine exerts on the malarial parasite, both in and outside the body, is exactly the same as that which is observed in the case of amœbæ and other similar forms. It is explained by the effects of the alkaloid as a protoplasmic poison, by virtue of which it acts more specifically on the lower forms of life than on the higher, and hence can be introduced into the human body with perfect safety in quantities which are sufficient to destroy such simple organisms. In addition to this

direct action, it is held by some that quinine has an indirect action, manifesting itself in an alteration of the environment, in consequence of which the latter is rendered less favorable to the growth of the parasite. As an example of this is cited the diminished readiness with which the red blood-corpuscles part with their oxygen after the addition of quinine. Both theory and experience, it has been observed, point to the decline of the fever as the most advantageous time for the administration of the drug. Some prefer to give a single large dose (usually about 1 gm.; 15 gr.), and others divided doses, of about 0.30 gm. (5 gr.), at intervals between the attacks. Since the elimination of quinine takes place with considerable rapidity, the maximum curative effect is believed to be obtained by the administration of the whole amount required in one dose, rather than by a succession of small doses. As the result of an extended observation the most effective method of treating an intermittent is to give a full dose of quinine (0.60 gm.; 10 gr.) in the sweating stage, and the same quantity five hours before the time of the next paroxysm. The anti-periodic property of quinine is increased, while the cerebral effects of large doses are diminished, by combination with morphine. If in any case a very prompt effect is desired, from 2 gm. (30 gr.) of quinine and urea hydrochloride, which is soluble in less than its weight of water, may be administered hypodermatically; a smaller dose, 0.30 gm. (5 gr.) in an hour or two, is almost invariably successful in preventing the next immediate chill. After the paroxysms have been overcome the remedy should not be entirely abandoned, but, for at least three weeks, on the seventh day from the date when the last one appeared full cinchonism should be produced, by the use of 1 gm. (15 gr.) of quinine, as the attacks show a decided tendency to recur in cycles of seven days. A preliminary dose of 4 mils (1 fl. dr.) of fluidextract of ergot, given two hours before the administration of the quinine will often aid the efficacy of the latter. It has been found that the action of the quinine is materially assisted by the continuous administration of arsenic during the intermissions, and until the third septenary period has passed. Quinine is both curative and prophylactic, and it has in numberless instances been proved that its regular administration in very moderate quantities (0.30 gm.; 5 gr. daily) will absolutely, or to large degree, protect persons living in malarious regions from ague. If the malarial poison is active, and

the conditions are otherwise unfavorable, the amount should be doubled; and it is to be noted that an enormous experience has now shown that the drug when taken thus as a prophylactic is entirely free from injurious effects. In remittent fever the best plan of administration is to give 2 gm. (30 gr.) of quinine in a single dose once or twice each day until the temperature is reduced to normal. In the pernicious variety of malarial fever the patient's life is in imminent danger, and not only are large doses of quinine, 3.80 gm. (60 gr.), demanded, but they must be given promptly; so that administration by the stomach, rectum and hypodermatic injection may be in turn or simultaneously practised. In any severe attack of ague, Clark's powder, which consists of quinine, 10; powdered capsicum, 4; powdered opium, 1 part, may be resorted to. This is usually given in 1 gm. (15 gr.) doses, and is more efficacious in the treatment of the disease than larger doses of quinine when given alone. In chronic malarial infection quinine is less curative than in the acute; the principal reason for this probably being the presence of certain structural alterations resulting therefrom in the liver, spleen, kidneys, intestines or central nervous system. Here quinine and the salicylates are more effective, and they may often be combined advantageously, according to circumstances, with iron, arsenic or so-called cholagogue cathartics such as the preparations of podophyllum. When an individual has once suffered from malaria any subsequent affection which he has is apt to assume a malarial type. This is especially true of neuralgia, which is often located in the forehead and has received the name of "brow-ague." It generally yields promptly to quinine, which is also sometimes of service in neuralgias not of malarial origin. Not only superficial neuralgias in various portions of the body, but also neuralgic pains in any of the deep-seated organs, may be an expression of the malarial cachexia as affecting the sensory nervous system; while its influence on the motor apparatus may be shown by such disorders as chorea, epilepsy, asthma, hiccough, laryngismus stridulus, and spasmodic stricture of the urethra. These neuroses, it has been found, may either be substituted for the ordinary malarial paroxysm (chill, fever and sweating) or may assume a periodical character in consequence of having occurred in a patient already affected with malaria. They are to be distinguished from other functional nervous affections by the more uniform periodicity in the recurrence of the paroxysms,

and if the patient is known to have previously suffered from malarial infection the diagnosis is usually simple. In the presence of malarial neuralgias particularly, morphine is of material service as an adjunct to the action of quinine. Malarial diarrhœa, dysentery and jaundice may sometimes be promptly relieved by quinine, but if these depend on structural alterations in the liver or the intestinal glands they are naturally more intractable. Hæmaturia of malarial origin usually requires large doses of the remedy. *Warburg's tincture* is a remedy which has long enjoyed a considerable reputation in the treatment of malarial infection, especially in the tropics. It contains quinine sulphate, 80; Socotrine aloes, 100; opium, 1; rhubarb, 32; camphor, 8; with a number of aromatics and menstruum to 4000. The proportion of quinine is about 0.60 gm. (9½ gr.) to 30 mils (1 fl. oz.) of menstruum, and the dose is 4 to 15 mils (1 to 4 fl. dr.). In many instances this preparation is prescribed without the aloes. In enlarged spleen (ague-cake) and in conditions, such as malarial jaundice, where there is great irritability of the stomach or of the intestinal mucous membrane, as well as in all patients where it becomes necessary to secure the promptest possible effect, it is advisable that quinine should be administered subcutaneously. The simple alkaloid and quinine sulphate are not adapted for this purpose, as they produce too much irritation, and have even been known to give rise to tetanus; and hence it is requisite to use some more soluble preparation of quinine, such as quinine and urea hydrochloride, which is now official.

Other Uses.—Quinine has been employed in a great variety of conditions besides those already mentioned, and in many of them with good results. There is no question of its distinct value in the treatment of whooping-cough, which there is good reason to suppose is a microbic disease. In order to get the full benefit of its remedial agency, however, it should be slowly swallowed in solution, so that it may act locally on the mucous membrane of the fauces as well as produce an internal effect; and given in this way its intensely bitter taste proves an almost insuperable objection, as it is extremely difficult to get children to take it. Still, in other forms it has been found of considerable service by a number of observers. It may therefore be combined with chocolate or administered by the rectum in suppositories or enemata. It is advised that if the patient is an infant under one year the treatment should be commenced with

as many centigrammes as its age in months, and that older children should take daily as many decigrammes as their age in years. Under no conditions, however, should the amount taken in a single day exceed 1.5 gm. (23 gr.).

In influenza, quinine, either alone or combined with other remedies, has been used with some success, and it is also claimed that it is of value as a prophylactic in this disease. In acute infectious pneumonia 1 gm. (15 gr.) of the quinine and urea hydrochloride may be administered hypodermatically every two or three hours, to three or possibly four doses. While this method often yields brilliant results in the influenzal pneumonias it is by no means a specific treatment. When an attack has commenced it is said that its early administration tends to prevent or diminish cardiac complications, as well as other complications and sequelæ. In certain cerebral affections it is of decided benefit. In the instance of elderly people it improves the intra-cranial circulation, and so relieves a group of symptoms depending on sluggishness of the latter which has been described as follows: Headache, vertigo, failure of memory and despondency, associated with a slow pulse, an atheromatous degeneration of the vessels, puffiness of the eyelids, and dilatation of the superficial veins of the head. In the adynamic form of delirium tremens small doses of quinine are of service in tranquillizing the patient, and in the preliminary stage of the affection known as "the horrors" has been found useful, especially when combined with a mineral acid, by correcting the digestion and invigorating the cerebral motor centers. As an adjuvant to other treatment, quinine is of value in adynamic diseases, such as diphtheria, and in surgical affections, where it aids in sustaining the vital powers and tends to check the formation of pus; as well as in cutaneous diseases like erysipelas, pemphigus, erythema nodosum, ecthyma, exfoliative dermatitis, pityriasis rubra, and impetigo, practicularly where there is an enfeebled condition of the system. A coryza may often be successfully aborted by the administration of 0.60 gm (10 gr.) of quinine with 0.015 gm. (¼ gr.), or less, of morphine at the onset of the attack. Quinine has also been found of service in the treatment of the symptom asthma and hay-fever after the subsidence of the acute symptoms, in chronic bronchitis with bronchorrhœa, and in the night-sweats of pulmonary tuberculosis. For the latter, doses of usually 1 gm. (15 gr.) are required. A full dose is fre-

quently given previous to the passage of the catheter or urethral sound, in order to prevent the occurrence of a chill.

Quinine is found useful by obstetricians in promoting uterine contractions after labor has once commenced, and is also thought to materially reduce the danger from sepsis. As an emmenagogue for anæmic subjects it is often combined with iron, and iron and quinine citrate is a good preparation for this purpose. There are certain patients in which quinine should, if possible, be avoided: Idiosyncrasy, in consequence of which quite small doses produce very severe cinchonism, acute or subacute disease of the middle ear, gastro-intestinal irritation, meningitis, and inflammation of the genito-urinary tract.

DIVISION II.—DRUGS ACTING ON THE BLOOD

A. Drugs Acting on the Plasma.—Substances of various kinds are capable, after absorption, of existing in solution in the plasma, and those which act as purgatives, diuretics and diaphoretics must necessarily alter the composition of the plasma by abstracting substances from it. The object for which drugs are given to act on the plasma is to increase its alkalinity. Were it even desirable to render it acid, no agent is at present known which is able to accomplish this, or even to reduce to any extent the natural alkalinity of the plasma. The mineral acids, as is well known, can exist in it only in the form of neutral salts.

The alkalizers of the plasma are salts of—

(1) **Potassium** (powerful).	(3) **Ammonium.**	(5) **Magnesium.**
(2) **Sodium.**	(4) **Lithium.**	(6) **Calcium** (feeble).

It has been found that in the plasma the decomposition of the citrates and tartrates of these metals into alkaline carbonates takes place, and one of the purposes for which alkalies are administered is to cause, if possible, the formation of soluble urates by their combination with uric acid. Furthermore, the excretion of the urates is promoted by the diuretic action of the alkalies.

Therapeutics.—Alkalies are consequently very largely employed in the treatment of gouty conditions, which are characterized by an

excess of uric acid or an analogous substance in the plasma. Lithium preparations have been regarded by many as especially beneficial in such cases, but there is no reason to suppose that this is a fact, particularly as the solubility of the urates is not increased by lithium. What is important is that the preparation selected should be one that is not apt to disturb the digestion, since the remedy must usually be continued for a considerable period; hence potassium citrate and lithium citrate are favorite salts, and the numerous natural alkaline waters are also very largely used. No doubt, one of the chief services which the latter render is the flushing of the system with a large amount of fluid.

On the hypothesis that acute articular rheumatism is due to a *materies morbi* in the plasma, by some believed to be lactic acid, which is generated within the body, large doses of the alkalies were long given in this and other affections involving a so-called rheumatic diathesis, with the idea of neutralizing and eliminating such morbid principle from the blood. This treatment, however, has now been practically supplanted by the use of salicylic acid and its compounds.

In chronic lead poisoning potassium iodide has been and is still almost universally employed. It has been supposed to promote the elimination by the kidneys of the lead, which accumulates in the tissues in a very sparingly soluble form, though it has now been denied that this salt has any effect on its excretion either by the urine or the intestine, by which most of the lead is known to make its escape from the body.

Purgatives, diaphoretics and **diuretics** necessarily have the effect of altering the composition of the plasma, and hence are frequently employed in the treatment of local or general œdema and of effusion into serous cavities, for the purpose of draining off fluid from the plasma. They are also used to facilitate the excretion of poisons from the blood in conditions such as uræmia and cholæmia. Venesection, transfusion and the intravenous injection of various aqueous solutions naturally alter the composition of the plasma directly.

B. Drugs Acting on the Red Corpuscles.—The most important are those which are capable of increasing the amount of hæmoglobin. It is a fact, however, that there are no known drugs which will increase the amount of iron in perfectly healthy blood; hence, in a strict sense, the action of all such agents must be regarded rather as a

pathological than a physiological one. These drugs are called **Hæmatinics.**

They are—

(1) **Iron and its salts.**	(4) **Copper salts**	(doubtful).
(2) **Arsenic trioxide.**	(5) **Hydrochloric acid**	
(3) **Potassium permanganate** (doubtful).	(6) **Potassium salts**	
	(7) **Phosphorus**	

These increase the quantity of hæmoglobin in each red corpuscle, as well as the number of these corpuscles. Their effects are materially assisted by all measures which tend to improve the digestion and the general health. The mode of action of these hæmatinics is still obscure, and will be discussed under each drug. Iron is by far the most important and efficient.

Indirect hæmatinics are drugs which are of service by removing some obvious cause for a deficiency of hæmoglobin (the condition known as anæmia), such as mercury, given for syphilis, quinine, for ague, etc.

Alcohol and quinine slightly diminish the oxygenating power of the blood by increasing the stability of the oxyhæmoglobin. Citrates and tartrates of the alkaline metals, in small doses, are partially oxidized to carbonates at the expense of the oxygen of the red blood-corpuscles.

The red blood-corpuscles are believed to be increased in size by oxygen and hydrocyanic acid, and to be rendered smaller by morphine and carbon dioxide, as well as by quinine, when, with a high temperature, as is probably the fact, they are a little larger than normal. By small doses of mercury they are said to be increased in number.

In consequence of the presence of a large amount of sodium chloride, the red corpuscles pass rapidly through the walls of the capillaries.

Quinine and hydrocyanic acid diminish the ozonizing power of the blood.

Certain drugs destroy life by **altering the composition of the hæmoglobin,** and so preventing it from uniting with oxygen. Whatever their therapeutic effects, they are therefore of considerable importance from a physiological and toxicological point of view. Thus, carbon dioxide expels the oxygen from oxyhæmoglobin; hydrocyanic acid forms cyano-hæmoglobin; potassium chlorate, the nitrites, especially amyl nitrite, and most of the antipyretics (antipyrine excepted) convert the hæmoglobin into methhæmoglobin; acetanilid, amyl nitrite, potassium chlorate and pyrogallic acid, either in large doses or after prolonged use, destroy the red corpuscles.

Phosphorus, arsenic, hydrogen sulphide, turpentine, iodine, and sulphur also reduce oxyhæmoglobin.

Hydrocyanic acid, alcohol, chloroform, quinine, morphine, and strychnine have the effect of diminishing the oxidation of freshly drawn blood which is exposed to the air.

C. Drugs Acting on the White Corpuscles.—Normally the white corpuscles undergo constant changes of form and position exactly similar to those of the amœba, and it is found that generally those drugs which are poisons to the amœbæ are, when applied in sufficient concentration (which is rarely the case in the human body), toxic to the leucocytes. All irritants which set up inflammatory action have the effect of causing the passage of white corpuscles through the capillary walls; while all the **cinchona alkaloids,** and especially quinine, have the property of arresting this migration. **Acetanilid,** although to a much less extent, acts in a similar way.

Veratrine destroys white corpuscles when applied to them outside the body.

Camphor, myrrh and other aromatics are said to increase their production by increasing absorption from the intestine, while quinine, it is believed, diminishes their number in the blood.

D. Drugs Altering the Coagulability of the Blood.

Those which increase it are—	
(1) **Calcium Salts** (especially the chloride and lactate.)	(2) **Magnesium Carbonate.** (3) **Various Astringents.**
Those which diminish it are—	
(1) **Citric Acid.**	(2) **Alcohol.**

Poisonous doses of mercury increase the fluidity of the blood, impair its coagulability, and diminish its solids. Phosphorus may also prevent the blood from clotting so readily as usual, and sometimes may cause it to remain fluid for forty-eight hours or more, but this is thought to be probably secondary to changes produced in the intestine and liver, rather than a direct effect of the poison. Cod liver oil increases the solids of the blood.

Therapeutics.—The calcium salts, particularly the chloride and lactate, are frequently administered to bleeders before imperative surgical operations. They are also useful in the treatment of hæmophilia and various purpuras. The drugs which diminish the coagulability of the blood are rarely, if ever, used for that purpose.

Drugs Acting on the Plasma

POTASSIUM

Potassium Hydroxide

For the Preparations of Potassium Hydroxide *see* p. 56.

Action of Potassium Hydroxide

In the hydroxides and carbonates of the alkalies the action of their basic metallic constituents is now known to be of little practical importance, the alkalinity of the substance mainly determining its pharmacological effects. The metallic ion serves for the most part as merely the means of applying the non-metallic constituent.

Action of Potassium Salts in General.—In the salts of the latter character it is seen that potassium has a distinctly toxic action, the principal effects of which are **depression** of the **central nervous system** and of the **heart,** shown by the pulse becoming much slower and weaker and by a sudden fall of arterial pressure. But while in instances of poisoning by quantities far in excess of therapeutic doses the special toxic action of potassium upon the heart may, no doubt, have an important share in bringing about the fatal result, the effects noted are in many instances believed to be due to the action of the poison upon the alimentary canal. Upon the brain and the motor and sensory nerves, and upon the spinal cord especially, as well as upon the heart and the muscles in general, potassium salts exert a pronounced depressant influence. The chief nervous symptoms are great muscular weakness and apathy, the respiration becomes rapid and labored, probably from the anæmia of the centers, and death is often preceded by asphyxial convulsions.

It is a fact, however, that when administered in ordinary medicinal doses these salts are not at any time present in the blood, owing to the rapidity of excretion, in sufficient quantities to produce marked toxic effects. Their poisonous action upon the heart has given rise to exaggerated apprehensions of the danger of using them in therapeutics, and it should therefore be borne in mind that only very large quantities have any effect at all upon the heart, especially when given by the mouth. In this connection it has been pointed out that very much larger quantities of potassium are taken daily in the food

by thousands of persons than are ever prescribed in medicine, the amount of it in the food of some classes being estimated as large as 100 gm. (3 oz.) per day. Still, the possibility of causing undesirable cardiac depression when potassium salts are given in large and long-continued doses should lead to caution in their use, and especially in persons suffering from cardiac disease. It is also well to remember that when administered in considerable quantity for an extended period they are likely, as has been found, to have the effect of dissolving out the hæmoglobin from the red corpuscles, and so produce a dyscrasia, with impoverishment and excessive fluidity of the blood.

External.—In concentrated form potassium hydroxide has a **powerful irritant and caustic action,** partly in consequence of its combining with the water of the tissues to which it is applied. In addition, it combines with the tissue elements to form alkaline albuminates, and with the fats to form soaps. In this way it dissolves the skin and produces necrosis of the deeper tissues. The surface generally becomes coated with a semi-transparent crust, and this eschar is subsequently separated by inflammation from the uninjured parts, leaving an ulcer. As potassium hydroxide forms soluble compounds with the proteids, it is slowly neutralized by the tissues, penetrating more readily than many other corrosives. In weak solution it thoroughly cleanses the skin by dissolving the superficial layer of the *stratum corneum* and the oily secretions of the glands, but if applied for some time it penetrates more deeply and may excite slight irritation and redness. On the mucous membranes it dissolves mucus. Very dilute solutions apparently have a sedative effect; strong solutions destroy all living tissues with which they come in contact.

Internal. *Alimentary Tract. Mouth.*—It has the characteristic alkaline taste of the hydroxides and carbonates. In very weak solution it simply causes a reflex flow of saliva. In more concentrated form it dissolves the mucous secretions and the superficial layers of the lining membrane, the irritation changing to a bright red the lips, tongue and general surface of the oral cavity, which feels soapy to the touch. Still stronger solutions have, as on the skin, a powerful escharotic effect, which extends to the throat and œsophagus, and may either prove immediately fatal or give rise to subsequent cicatrization and stenosis. The accidental swallowing of caustic

alkalies is probably the most frequent cause of cicatricial stricture of the œsophagus.

Stomach.—As in the œsophagus, concentrated solutions produce an amount of corrosion sufficient to destroy life in a short time, or which may be followed subsequently by gastric ulcer or scar-formation. They may prove immediately fatal by causing perforation into the peritoneal cavity. Small quantities of the drug appear to be soon neutralized by the hydrochloric acid of the gastric juice, and act no longer from their alkalinity, but merely from their effects as a salt, if at all. Larger quantities render the contents of the stomach neutral or alkaline, diminish the activity of the pepsin, and tend to prevent gastric digestion. It has been demonstrated that the alkalies have no effect whatever on the activity of the secretory glands of the stomach, while, on the other hand, they may affect the juice already secreted by making it neutral, or even alkaline, and thus completely interfere with its usefulness. In hyperacidity of the stomach, however, they may prove of benefit by lessening the amount of free acid present, if given after meals.

Intestines.—It is thought to be absorbed in combination with proteids, and disappears rapidly from both the stomach and small intestine. In the latter it is found to have an indirect effect, in consequence of its diminishing the acidity of the gastric juice. Hence the secretion of the pancreas, which is normally stimulated by the acid fluid passing from the pylorus, is materially lessened. While, however, this again may render digestion less complete, the greater alkalinity of the intestinal contents no doubt tends to increase the efficiency of the pancreatic juice already secreted. It has been shown that alkaline salts do not increase the secretion of bile, are not excreted in it, and do not cause any change in its reaction. It is therefore inferred that any effect which these may exert in affections of the liver are due to their effects in the duodenum. In therapeutic doses they apparently have no effect on intestinal putrefaction, but it is stated that very large quantities (15 gm.; 4 dr.) increase the putrefaction, in consequence probably of their neutralizing the disinfectant gastric juice.

Blood.—It is believed to exist in the blood chiefly as the carbonate. The alkalinity of that fluid, like that of the body in general, is increased; but the organism rapidly frees itself from the excess of alkali by excreting alkaline salts.

Respiratory Passages.—The bronchial secretion appears to be increased in quantity and also rendered less viscid.

Nervous System.—Among the effects, the **reflex influence** on the central nervous system is of great importance. In consequence of this, when the dose is large, shock may appear so rapidly and be of such violence as to completely overshadow the local symptoms, and death may occur from cardiac paralysis before these have had time to develop.

Urine.—The secretion of **urine is increased,** partly in consequence of the salt-action and partly, apparently, as the result of an irritant effect upon the renal epithelium. The absolute amount of all salts excreted is increased, although their percentage is naturally lessened, owing to the diuresis which is produced. The urine is temporarily rendered less acid or even alkaline. It generally soon regains its acidity, but under the use of repeated doses of sufficient amount its reaction may be kept alkaline indefinitely. Excretion takes place chiefly by the urine.

Metabolism.—The excretion of urea is sometimes increased and sometimes diminished, the explanation of this probably being that the local action of the alkali on the alimentary tract sometimes causes an increased formation and destruction of the white corpuscles of the blood, and thus increases the uric acid. Some observers have found that very large doses decrease the amount of the latter in the urine, while smaller ones have no effect on it. As regards the oxidation in the tissues, it is concluded that the amount of tissue waste is but little affected by the increased alkalinity of the blood, and that the slight changes observed may vary not only in different persons, and even in the same person at different times. The cause of this individual variation is attributed either to difference in the amount of acid formed in the tissues or to differences in the local effect of the alkalies in the alimentary tract.

Therapeutics of Potassium Hydroxide

External.—Potassium hydroxide is often used in the destruction of lupus, carcinomatous growths, etc., but its effects are somewhat difficult to limit, and great care should be taken in its application. On account of the thorough and penetrating character of its escharotic action it is to be preferred when a very deep and decided influence

is desired, as after the bite of a venomous snake or rabid dog. For cauterizing morbid or cicatricial tissues it is often best to employ it in the combination with lime, which is milder in its operation and more manageable than the pure salt. In using it it is generally first reduced to a paste with a little alcohol, its action being limited laterally by means of adhesive plaster and in depth by the duration of the application. After the withdrawal of the caustic, diluted vinegar may be applied in order to neutralize any alkali that may remain and to check destruction. It is often of service in phagedæna. It also proves a very satisfactory agent in the treatment of ingrowing toe-nail. The portion of nail to be removed is painted with a 40 per cent. solution of it, with the effect of rapidly softening its upper layer to such an extent that it can be readily scraped off. This procedure is repeated until the nail, which remains, is only a thin scale, which can be excised with fine scissors. The official solution may be employed to dissolve oily secretions and thoroughly cleanse the skin before operations, and, diluted, is sometimes used to remove the epidermis in some forms of chronic cutaneous disease. In like manner it softens callosities, such as corns and bunions, resulting from the effects of local pressure. In sufficiently weak solution its sedative influence tends to allay itching, and the following combination has been found efficient in pruritus: Solution of potassium hydroxide, 4; phenol, 4 to 8; oil of linseed, 30.

Internal.—It is not often used internally, except at times as an antacid for the relief of acid dyspepsia. It has been claimed that it is sometimes successful in reducing obesity, a result attributed to its stimulation of the processes of metabolism, with consequent increased oxidation of proteids and fats; but it seems more probable that in instances of this kind it acts by slowly poisoning the patient, producing disorganization of the blood and interfering with nutrition. Potassium hydroxide, however, is liable to cause gastric irritation, and hence to obtain the effects of alkalies upon internal organs potassium bicarbonate, citrate and acetate are usually employed in preference to it.

TOXICOLOGY

See Sodium Hydroxide, p. 379.

POTASSIUM CARBONATE AND BICARBONATE

For the Preparations of the Potassium Carbonates *see* p. 57.

Action of the Potassium Carbonates

The action of potassium carbonate is essentially the same as that of potassium hydroxide, except that it is much less corrosive. In solution it rarely induces actual lesions of the skin unless after very prolonged application. The hydroxides are much more powerful solvents than the carbonates, and these than the bicarbonates. Hence potassium bicarbonate is but very feebly caustic. Otherwise its pharmacological action is the same as that of the carbonate.

Therapeutics of the Potassium Carbonates

In weak solution or as a paste the carbonate is sometimes used externally for the relief of itching in cutaneous diseases. It is also employed in baths, where its irritant action is made use of to soften the epidermis and cause stimulation of extensive areas, as is often desirable in such affections as ichthyosis. For internal use potassium bicarbonate is almost invariably preferred, since the carbonate is too irritating to the stomach.

Stomach.—While it is always advisable to remove the cause, if possible, the alkalies often serve a very useful purpose in the treatment of dyspepsia. Sodium bicarbonate is much more generally relied upon to give relief, particularly in hyperacidity, than the potassium salt. Where no excessive acidity exists, however, the latter is often preferred, and is commonly efficacious in relieving the distention and discomfort, when given in small doses and well diluted. Alkalies are of great service when there is impaired digestion of fats, not only **preventing the formation of butyric acid,** but also assisting the **emulsification and absorption of the fats,** especially in affections of the liver, and when from any cause the flow of bile into the intestine is interferred with. In these conditions potassium bicarbonate is considered preferable to other alkaline remedies. Potassium bicarbonate should not be employed as an alkali in instances of poisoning by mineral acids, on account of the evolution of carbon dioxide gas which is likely to result.

Blood.—The absorption of both hydroxides and carbonates leads to an increase in the alkalinity of the blood and tissues. Potassium bicarbonate and other alkalies have been used very extensively in the treatment of gout, rheumatism and the so-called uric acid

diathesis generally; there is clinical evidence that the alkalies are of some value in gout and rheumatism, although in the treatment of the latter disease they have, to a large extent, fallen into disuse since the introduction of the salicylates. It must be confessed, therefore, that their mode of action is not clearly understood, though there is some ground for the belief that these agents may influence the formation, rather than the excretion, of uric acid. In acute rheumatism it has been shown that any influence exerted by the alkaline treatment in cutting short the disease, lowering temperature, and relieving pain, is in no way comparable to that of the salicylates. The opinion is still held that alkalies have a decided effect in preventing and relieving cardiac complications, and thus succeed, to some extent where the salicylates fail. Hence it is the practice of some to associate the latter with alkalies. In acute rheumatism, potassium bicarbonate may be given in doses of 1.20 gm. (20 gr.) every two to four hours, or 15 gm. (4 dr.), or more, may be dissolved in barley water, and administered as a drink during the twenty-four hours. As the remedy is very distasteful to most persons, it may be given in effervescence with lemon-juice, or with citric acid solution. An equal quantity of potassium citrate is sometimes prescribed with the carbonate when given in this way. It has been found that the alkaline treatment, however well adapted it may be to plethoric and muscular individuals, is not usually suited to the delicate and anæmic.

Other Uses.—Potassium bicarbonate is not infrequently used with benefit for jaundice and gall-stones. It probably has no direct effect on the bile, except perhaps in increasing its fluidity, but affords relief principally by lessening duodenal irritation. In bronchitis, added to other expectorants, it serves to increase the secretion and render it less viscid and tenacious.

POTASSIUM ACETATE AND CITRATE

For the Preparations of Potassium Acetate and Citrate see p. 58.

Action of Potassium Acetate and Citrate

External.—Neither of them has any external action.

Internal.—They are the least irritating to the stomach of all the potassium salts, and, with the exception of the tartrate, the citrate is

the least offensive to the palate. They have the advantage of not neutralizing the gastric juice, or in any way affecting the digestion except from their salt-action, which may be minimized by administration in dilute solution. Being decomposed in the body, with the formation of carbonates, they exert an alkaline action after absorption, and this has the effect of increasing the **alkalinity of the blood and of the urine,** and of producing **free diuresis.** On account of its influence on the urinary secretion the acetate was formerly known as *sal diureticus.* The citrate is not so readily absorbed as the acetate, and therefore tends to act on the bowels but is not cathartic except in large quantities. They both have some **diaphoretic** action, which is rather more marked in the instance of the citrate.

Therapeutics of Potassium Acetate and Citrate

Internal. *Blood.*—Both these salts are largely employed in gouty conditions, and were formerly much used also in the alkaline treatment of acute rheumatism. The citrate dissolved in an excess of lemon juice affords the most agreeable method of securing the influence of an alkaline potassium salt upon the system. They have some **antiscorbutic** effect, but are not so efficient in the prevention and treatment of scurvy as lemon-juice, lime-juice, and fresh vegetables.

Kidneys.—They are constantly used for their diuretic effect in feverishness, scarlatinal dropsy, chronic renal disease, general dropsy from valvular disease of the heart, and other conditions. Alkaline diuretics are of very little value, however, in dropsical accumulations in the various cavities. The best effects are usually obtained from a combination with such diuretic remedies, as squill, spirit of nitrous ether, etc. In irritation of the urinary organs resulting from an excess of acid and in inflammatory conditions of the passages, in which the acid urine acts as an irritant, they are of great service by **rendering the urine alkaline,** and they possess the advantage over other potassium salts of not interfering with digestion. In such conditions the solution of potassium citrate is highly esteemed. It was long the opinion, and is still held by many, that the continued use of these salts will effect the solution of renal calculi, which are usually composed principally of uric acid. The fact that in certain instances alkaline treatment has been observed to cause the breaking up of large stones into small fragments is

explained on the hypothesis that the calculi were composed originally of small fragments glued together by mucus, and that the alkali caused the solution of the latter. Furthermore, it is claimed that the alkalies are to some extent objectionable in vesical calculus, inasmuch as alkaline urine is liable to deposit phosphates in the bladder, and thus rather to increase the size of the stone than to diminish it. Still, there can be no question that in many of the forms of **irritation of the urinary passages,** from gravel, stone, cystitis, stricture, enlarged prostate, etc., such agents as potassium citrate and acetate afford great relief whenever the urine is acid in reaction. There is also authority for the opinion that they are of utility in the prevention of uric acid gravel, it being held that the most potent factor, in determining the precipitation of free crystalline uric acid in the urinary passages, is a high degree of acidity in the urine; so that if the latter be rendered alkaline, or only faintly acid, no such precipitation can occur. In the daytime the alkaline tide following the ingestion of meals will usually keep the urine from attaining an acidity sufficient for the precipitation to occur, but during the fasting hours of the night the opportunity for this is afforded. Hence, it is advised that a moderately large dose of an alkali, such as 4 gm. (60 gr.) of potassium citrate should be taken at bedtime. In case this is not sufficient to prevent the hyperacidity during all the hours of sleep, a second dose should be taken in the course of the night, while in exceptional instances the tendency to uric acid precipitation may be so great as to require the use of the remedy in the daytime also. This preventive treatment, it can readily be seen, may be materially aided by a judicious arrangement of the meals, so as to avoid unnecessarily prolonged periods of fasting.

Skin.—In feverish conditions such as frequently result from an ordinary cold, they are of service on account of their diaphoretic as well as their diuretic action.

Respiratory Passages.—Like potassium bicarbonate, they are of considerable utility in bronchitis, assisting the action of other expectorants by increasing the secretion and by rendering it more fluid and more easily expectorated.

POTASSIUM BITARTRATE

For the Preparations of Potassium Bitartrate *see* p. 59.

Action of Potassium Bitartrate

External.—The aqueous solution of potassium bitartrate is only slightly acid; has no external action.

Internal. *Intestines.*—It is a **hydragogue saline cathartic,** drawing fluid from the blood and tissues into the intestine, and consequently rendering the blood more concentrated than usual. This leads to a sensation of thirst and to a lessened excretion of fluid by the kidneys and other glands. It produces rather profuse watery stools, with practically no irritation or griping.

Kidneys.—This salt, which is but slowly absorbed, is to a large extent excreted unchanged in the urine and fæces. That portion which is absorbed is converted into carbonate, which has a decided **diuretic** effect and also tends to render the **urine alkaline.**

Therapeutics of Potassium Bitartrate

Internal. *Gastro-Intestinal Tract.*—It is frequently employed as a cooling aperient, and for this purpose a dose of it (8 gm.; 2 dr.) may be dissolved in a glass of hot water, and sipped during dressing in the morning. Its use should not be continued too long, however, as it is liable to impair nutrition. In doses of 30 gm. (1 oz.) it is a valuable hydragogue cathartic, particularly in ascites and uræmia. It is often combined with jalap, as in compound jalap powder. With sulphur it constitutes a convenient laxative when hæmorrhoids are present. With magnesia it is sometimes prescribed to remedy habitual vomiting arising from gastric acidity and also in the vomiting of pregnancy.

Kidneys.—The bitartrate is highly esteened as a **diuretic,** and 30 gm. (1 oz.) in 500 mils (1 pt.) of infusion of juniper-berries, taken in divided doses during the twenty-four hours, is often very serviceable in ascites. This is too irritating to the kidneys, however, to be used in acute desquamative nephritis. Cream of tartar whey is made by dissolving about 8 gm. (2 dr.) of the bitartrate in 500 mils (1 pt.) of milk. The beverage known as "imperial" (*potus imperialis*) may be used with advantage in some febrile affections. It consists of potassium bitartrate, 4 gm. (1 dr.); benzosulphinide, 0.06 gm. (1 gr.); oil of lemon, 0.20 mil (3 ♏); to 500 mils (1 pt.) boiling water. The bitartrate is also conveniently given in ordinary lemonade, the salt

being dissolved in hot water and the solution allowed to cool before the lemons are added to it.

Liver.—In hepatic cirrhosis, whether due to alcoholism or other causes, as well as in chronic peritonitis, good results are said to be sometimes obtained from potassium bitartrate: it has, also, been used in the treatment of gall-stone disease.

POTASSIUM NITRATE

For the Preparation of Potassium Nitrate *see* p. 59.

Action of Potassium Nitrate

External.—It has no action on the unabraded skin, but is irritant to mucous membranes and raw surfaces.

Internal.—*Gastro-intestinal Tract.*—In large quantities it is a decided **gastro-intestinal irritant,** producing nausea, vomiting, intense burning pain in the stomach, and sometimes purging. In some instances blood is present in the vomited matter and in the stools. After death there is found congestion of the stomach and intestines, and there may be extravasations of blood. Even ulceration and corrosion of the mucous membrane have been observed. When it is very freely diluted, considerable quantities may be taken without serious results.

Blood.—External to the body, nitrates have the effect of preventing the coagulation of the blood and of dissolving clots already formed. In the body they are said to have some influence on the red blood-corpuscles, which become crenated; but it is thought that this is probably merely the salt-action. By reason of its high power of diffusion, potassium nitrate rapidly passes into the blood unchanged.

Heart.—It is so violently irritant that the local symptoms produced by toxic quantities are apt to overshadow the effects on the system of its potassium-ion. The latter, however, is **depressant** to the heart, weakening its movements and finally arresting them.

Nervous System and Muscles.—Sometimes the nervous symptoms predominate, and the collapse caused by the drug may be accompanied with paralysis of the lower extremities. It tends to exert a paralyzing influence upon the spinal cord, and produces great

muscular weakness and reduction of reflex sensibility. It also may act toward paralyzing unstriped muscular fiber.

Respiration.—Large doses retard the respiration.

Skin.—It has a slight **diaphoretic** effect.

Kidneys.—In moderate amounts it has considerable **diuretic** influence, which is believed to be due, in part, to the salt-action and partly to a true stimulation of the kidney, such as is exerted by many other intestinal irritants. Large quantities tend to produce renal inflammation and hæmaturia, and in some instances of poisoning the kidney is recorded to have presented the lesions of acute nephritis, and also hæmorrhages.

Elimination.—Some of the nitrate given by the mouth is usually found unchanged in the urine, but the greater portion disappears in the tissues. Its fate in the body is not certainly known, but it is supposed that it is eventually excreted by the lungs as free nitrogen. Some of the nitrate is apparently excreted in the saliva and perspiration; it may be unchanged, although it is said to be rapidly reduced to the nitrite in these secretions, and may in fact be changed to this form in the secretory cells.

Therapeutics of Potassium Nitrate

It is stated to be sometimes of value in the treatment of hæmorrhage, more particularly hæmoptysis accompanied with febrile movement, and to have been given with advantage in purpura simplex in 0.60 gm. (10 gr.) doses and in purpura hæmorrhagica in the same or larger amount.

As a diuretic it has been generally superseded by the citrate and acetate, but is still used by some, with digitalis and other drugs. When given internally it is recommended that it should be carbonated in order that its absorption may be accelerated and the gastric irritation proportionately lessened. By reason of its influence on the respiration and on unstriped muscular fiber, potassium nitrate acts as an **antispasmodic,** and the one purpose for which it is now employed is the relief of the symptom asthma. For the treatment of this, blotting paper, dipped in a saturated solution of potassium nitrate and then dried, is burned, and the patient inhales the fumes. It is advised by some that the paper should be also dipped in a solution of potassium chlorate. The fumes may

be diffused generally in the room, or if a more concentrated effect is desired the paper may be burned under a funnel, from the mouth of which the patient inspires. It is a common ingredient of so-called asthma powders, and is also sometimes used in the form of cigarettes.

POTASSIUM CHLORATE

For the Preparations of Potassium Chlorate *see* p. 59.

Action of Potassium Chlorate

External.—Locally it is disinfectant and stimulant to mucous membranes. It is easily decomposed by septic matter, and the nascent oxygen given off acts as a stimulant and antiseptic.

Internal. *Stomach and Intestines.*—Small doses have no effect. Sometimes the only effect of large doses in the alimentary canal is to cause some nausea and vomiting. In other instances the **irritation** caused by it is sufficient to excite gastro-enteritis. The first symptom is often prolonged and violent vomiting. There is severe gastric pain, and this may be followed by profuse diarrhœa. In subacute poisoning vomiting and diarrhœa are also observed, and the matter vomited usually contains bile, and sometimes blood. After death, swelling and ecchymoses of the mucous membrane of the stomach and intestines have been found.

Blood.—When added to blood, either outside or in the body, it causes the formation of **methæmoglobin** from the conversion of hæmoglobin; so that its administration in toxic quantity may produce an actual **asphyxia.** It also has the effect of subsequently causing the **destruction of the red blood-cells,** with resulting liberation of proteids. In the most acute form of intoxication death is due chiefly to asphyxia caused by the reduction of a large amount of hæmoglobin, but if the quantity of methæmoglobin thus formed is smaller, it is found that the latter gradually disappears. Hence, in the subacute form of poisoning sufficient hæmoglobin remains untransformed to continue the respiration of the tissues. When instances of this kind terminate fatally some of the red corpuscles are found altered in shape, others are colorless, and in some the pigment, instead of being generally diffused, is aggregated in masses. No methæmoglobin may be discovered, but the débris of the cor-

puscles can be found in the liver, spleen, bone-marrow and renal tubules. In acute poisoning the color of the blood is very dark and the methæmoglobin absorption band is found to be present in the spectrum.

Heart and Other Organs.—Toxic doses are likely to cause marked failure of the heart's action, excessive dyspnœa, and pronounced cyanosis of the surface. Increase in the amount of bile pigment results from the excessive destruction of red blood-corpuscles, and the absorption of the pigment from the hepatic capillaries may cause jaundice. After death both the liver and spleen have been found enlarged, from the deposition of the débris in them.

Nervous System.—Among the nervous symptoms noted are headache, delirium, tonic and clonic spasms, coma, and a peculiar stiffness of the extremities. These are believed to be due to the blood changes caused by the drug and to the uræmia resulting from its effects in the kidneys. The course of the poisoning may be very rapid, death having been known to be caused in two and a half hours; but usually it does not occur for several days. The fatal result may be due either to asphyxia, to collapse from cardiac weakness, or to uræmia. Death from uræmic symptoms may follow as late as a week after the appearance of the first signs of poisoning, while in several instances complete recovery has occurred even where the most severe effects had been caused.

Kidneys.—In the subacute form of poisoning the products of the destruction of the red blood-corpuscles are excreted in the urine, and in consequence the renal tubules become occluded with brown granular masses. These are found to be in part forced downward and to appear in the urine as casts, but may produce an almost complete suppression of urine and the consequent symptoms of uræmia. Probably as the result of the obstruction of the tubules, the epithelial cells may perhaps become inflamed, but often, it is stated, no actual nephritis is present. The chlorate passes unchanged through the body, being principally excreted in the urine, from which 90 to 96 per cent. of the amount given by the mouth has been recovered. It is also excreted in small quantities in the perspiration, saliva, tears, and probably all the other secretions, and is state to pass from the mother to the fœtus in utero. While the secondary effect of potassium chlorate may tend to produce suppression of the urine, through the results in the kidneys of its destruc-

tive influence on the red blood-cells, the absorption of concentrated solutions is often shortly followed by considerable **diuresis**, from an action upon the kidney similar to the local salt-action in the stomach which includes nausea and vomiting.

Therapeutics of Potassium Chlorate

Its internal use is now regarded as of little value, and may cause toxic symptoms; but locally it has distinctly **curative** effects upon **mucous membrane** in such conditions as catarrhal inflammation of the mouth and fauces, aphthous, ulcerative and mercurial stomatitis, and thrush, or nursing sore-mouth, as well as in acute tonsillitis. It may be applied in the form of a wash or gargle, and is sometimes associated with other agents. In young children solutions of it are used with glycerin, or honey, to wash out the mouth. It is sometimes given internally in solution, or in the form of lozenges, with the idea of obtaining its local effects while being swallowed and a subsequent similar effect from its excretion in the saliva. If the salt is employed internally it should always be administered with great caution, and care should be taken to avoid giving it when the stomach is empty. In diphtheria it has been thought especially effective in combination with tincture of ferric chloride and hydrochloric acid, in which, in addition to the local influence of the chlorate and the tonic effect of the iron, the action of free chlorine, generated in the mixture, is obtained. It should not be exhibited in full doses, however, on account of the depressing effects upon the heart, as well as the danger of renal disturbances.

TOXICOLOGY

As potassium chlorate is very largely used as a domestic remedy and is not regarded by the laity as a toxic agent, accidental poisoning from it is not unlikely to occur. The injurious effects of the drug have already been sufficiently described. In the treatment the stomach should be promptly evacuated if there is reason to suppose that any of the salt still remains in it. Demulcents such as white of egg, milk, flaxseed tea, or mucilage of acacia may be used, and ice given to control the vomiting. Each patient should be treated according to the special symptoms met with. Cardiac stimulants or stimulants to the central nervous system may be called for. As the destructive action of the chlorate upon the blood is believed to be less liable to occur when the latter is more alkaline than usual, the alkaline carbonates should generally be given in the hope of preventing or checking these effects. After the acute symptoms have passed off the admin-

istration of diuretics and large quantities of fluid is recommended for the purpose of washing out the kidneys and preventing the accumulation of detritus in the tubules.

SODIUM

Sodium Hydroxide

For the Preparations of Sodium Hydroxide *see* p. 60.

Action and Therapeutics of Sodium Hydroxide

Its action is practically the same as that of the potassium salt, but less depressant upon the cardiac, muscular and nervous systems. It must be borne in mind, however, that sodium hydroxide and carbonates, like the potassium hydroxide and carbonates, depend chiefly for their activity on their **alkalinity.** It is their hydroxyl-ion which induces the alkaline reaction of the solutions and determines their physiological effects.

It is very little used in medicine. Potassium hydroxide is almost always preferred.

TOXICOLOGY

Poisoning by caustic alkalies is not very commonly met with. In addition to potash and soda, it may be caused by the impure potassium carbonate (pearlash) or sodium carbonate (soap lees), which contain these alkalies. The carbonates, however, are much less corrosive than the hydroxides.

Symptoms.—The symptoms are those of a violent corrosive poison: burning heat in the throat, and stomach, intense thirst, salivation, vomiting of blood-stained matter, agonizing abdominal pain accompanied with diarrhœa, feeble pulse, cold, clammy skin, and general collapse. The lips, mouth, tongue and throat become swollen and assume a bright red color. The larynx is apt to be involved in the corrosive action, and œdema of the larnyx may cause death in a very brief time. If the patient should survive the immediate effects of the poison, he is very likely to suffer from more or less extensive ulceration or cicatrization of the mucous membrane of the throat, œsophagus or stomach, which may subsequently prove fatal. In every exceptional instances the local action may be comparatively slight and the poison expend itself chiefly upon the nervous system, with the result of producing muscular weakness, paralysis of the lower extremities, weak cardiac action and coma; and, as has been stated, very large doses cause death suddenly, through paralysis of the heart, before the local inflammation has had time to develop.

Post-mortem.—The mucous membrane, wherever the caustic has come in contact with it, is dark-colored, inflamed and covered with a grayish membrane.

The sloughs may be very extensive and deep, and there may even be complete destruction of a portion of the stomach wall. In the event of the patient having survived long enough for such a result to occur, there naturally will be found evidences of peritonitis resulting from this lesion. In the œsophagus the points especially affected will generally be found at its two ends and at the place where it crosses the left bronchus, and in the stomach, at the pylorus.

Treatment.—The stomach should be evacuated as promptly as possible, but it is not safe to use the stomach-pump for this purpose, as the tube is liable to perforate the corroded wall of the œsophagus or stomach. Any one of the following emetics may be resorted to: Apomorphine hydrochloride, 0.006 gm. (1/10 gr.), by subcutaneous injection; zinc sulphate, 1.20 gm. (20 gr.), or copper sulphate, 0.30 gm. (5 gr.), in 250 mils (½ pt.) of tepid water; powdered ipecac, 2.00 gm. (30 gr.) or syrup of ipecac, 30 mils (1 fl. oz.). The preparations of ipecac should not be employed if other emetics are available, as this drug, which produces vomiting chiefly by its influence on the medulla oblongata, is not sufficiently prompt in its action. If none of these agents is quickly attainable, domestic remedies such as mustard, 16 gm. (1 tablespoonful) or common salt, 30 gm. (2 tablespoonfuls), may be administered in 250 mils (½ pt.) of tepid water. At all events, plenty of luke-warm water should be given, and vomiting promoted by tickling the fauces. As soon as the stomach has been emptied some form of dilute acid should be employed. The organic acids are the best, and vinegar is almost always within easy reach. In place of it, lemon juice, acetic acid, or solution of citric acid (all of which should be well diluted with water) may be used. Demulcents such as white of egg, olive oil, or flaxseed tea are of service, and measures to counteract shock, heart failure, and collapse, such as the application of warmth, the exhibition of stimulants, etc., are generally called for.

MONOHYDRATED SODIUM CARBONATE

For the Preparations of Monohydrated Sodium Carbonate *see* p. 61.

Action and Therapeutics of Monohydrated Sodium Carbonate

As in the fact with potassium, the carbonate is much less corrosive than the hydroxide, otherwise the action is the same as that of caustic soda. Monohydrated sodium carbonate is, however, decidedly more irritating than the bicarbonate.

This is employed externally in the treatment of skin diseases in which the eruption is of a dry character, as lichen, prurigo, ichthyosis, psoriasis and pityriasis, and especially in the form of baths. 450 gm. (16 oz.) is dissolved in a sufficient quantity of tepid water, and it is advised that each bath should be at least an hour in duration. It has the effect of stimulating the affected portions of the skin, and at the same time of removing sebaceous and acid secretions. If,

however, there is already an irritable condition present, but a small quantity of the alkali should be used, and mucilage or bran may be added to the water to render the bath more bland. This treatment is generally unsuitable for vesicular and pustular eruptions, but may occasionally prove of service in them if the solution is made very weak. Lotions of it have been used in certain local eruptions, especially those of the scalp, and also in pruritus vulvæ. As an antidote to acids in corrosive poisoning, however, it is regarded as preferable to the bicarbonate, for the reason that less carbon dioxide is formed.

SODIUM BICARBONATE

For the Preparations of Sodium Bicarbonate *see* p. 61.

Action and Therapeutics of Sodium Bicarbonate

As regards general alkaline properties the action of sodium bicarbonate is the same as that of the potassium salt, but it is less rapidly absorbed from the alimentary canal. It is much more grateful to the stomach than either sodium or potassium carbonate.

External.—Either in saturated solution or as a fine powder sodium bicarbonate, locally applied, is the best remedy to relieve the pain from burns. Of late it has been strongly recommended to be used for packing to prevent pain after operations upon the vagina. To relieve **itching or burning,** as in erythema, urticaria, bites of insects a soothing lotion of 1 to 60 may be employed, and a saturated solution has been found an efficient cure in poisoning by *rhus toxicodendron.*

Internal.—In hyperacidity of the stomach, it is much more commonly used than any other alkali. Among the symptoms for the relief of which it may be employed are heartburn, sour eructations, œsophageal spasm, cramp in the stomach, colic, and irregular diarrhœa. In instances of **hyperacidity** it is commonly given one or two hours after meals, the period of marked hyperchlorhydria, often affording immediate relief, and, like other alkaline preparations, it should be always well diluted in order to avoid undue irritation. During digestion, it reduces gastric secretions, neutralizes some of the free hydrochloric acid setting free carbon dioxide, and is absorbed as sodium chloride. When the secretion does not seem

to contain an excessive amount of acid it is sometimes prescribed before meals when it will dissolve mucus and be directly absorbed into the blood; it may then be combined with other stomachics, such as bitters or volatile oils. If given at bedtime it may lessen the acidity of the early morning. Dilute solutions of the alkalies act as mild irritants to the stomach wall, and thus, it is thought, improve its circulation, and lessen pain, eructation and distention in the same way as other slight gastric irritants, such as the volatile oils, while as is the fact with the carbonates and bicarbonates this carminative action is strengthened by the carbon dioxide liberated by the hydrochloric acid. Furthermore, by their mild irritant action they increase secretion of mucus, and as they also have the effect of liquefying tenacious mucus, they serve to improve the condition of the stomach. In alcoholic subjects, the gastritis is relieved by sodium bicarbonate in solution, by lavage, which dissolves the large amount of viscid mucous. If there is hyperacidity in the intestine, rather than the stomach, sodium bicarbonate is not suitable, because it is likely to be neutralized or absorbed before reaching the seat of trouble. In this condition the insoluble alkaline earths or their carbonates should be advised, especially in the treatment of duodenal ulcer. While the immediate result of sodium bicarbonate in hyperacidity of the stomach is highly beneficial, the after-effect is to increase the production of acid; so that those who habitually use the remedy are extremely apt to suffer severely from acidity. It is very serviceable in the acid diarrhœa of infants and young children, where it is often given combined with demulcents or with the aromatic syrup of rhubarb. Brilliant results have been reported from the use of sodium bicarbonate and carbonate in the treatment of acidosis as in diabetic coma, when given early enough and in sufficient amount. If the alkali is used in the early stages before coma sets in, it is advised that it should be given in quantities of about 40 gm. (10 dr.) a day, while if coma has already supervened the amount should be 100 or 200 gm. (25 or 50 dr.). If catharsis occurs after these large doses, so much of the alkali may escape by the bowels that it may be impossible to secure the absorption of a sufficient quantity. In this event it may be given by intravenous injection of a 0.3 per cent. solution of the crystallized salt, as hypodermatic injection is apt to cause sloughing, but the results are not so likely to be so good since the blood in diabetes is unchanged as to

alkalinity if the hydroxyl-ions give certain evidence. It is insisted on that the administration of the remedy should not be left until coma actually occurs, but should be instituted as soon as the urine gives the characteristic reaction of acetone with ferric chloride. Since acidosis frequently occurs after surgical operations, often due to the anæsthetic, especially after chloroform, it is well to administer from 8 to 15 gm. (2 to 4 dr.) in solution previous to the surgical interference. In these doses it is quite likely to have a laxative effect. In digestive troubles sodium bicarbonate is often combined with compound tincture of gentian, and a common gastric sedative mixture consists of 0.60 gm. (10 gr.) each of sodium bicarbonate and bismuth subcarbonate, suspended in mucilage.

SODIUM PHOSPHATE, SODIUM SULPHATE, AND POTASSIUM AND SODIUM TARTRATE

For the Preparations of Sodium Phosphate, Sodium Sulphate, and of Potassium and Sodium Tartrate, *see* p. 62.

Action of Sodium Phosphate and Sulphate, and of Potassium and Sodium Tartrate

Internal. *Intestines.*—These are typical **saline cathartics,** not causing irritation of the intestine, except when given in very large quantities. They owe their action to retarded absorption, and their characteristic effect is due to their acid constituent. Saline cathartics cause the abstraction of fluid from the blood and its accumulation in the intestine. The quantity of liquid accumulated depends upon the nature and amount of the salt and the strength of the solution employed, and it has been found that the maximum amount corresponds closely to the quantity required to form a 5 or 6 per cent. solution of the salt employed. The liquid withdrawn from the blood is quickly replaced by liquid abstracted from the tissues, but there is a secondary concentration of the blood later, resulting from the subsequent diuresis occasioned by the portion of the salt absorbed. After the maximum of accumulation in the intestine is reached, the fluid is gradually absorbed, and a soft painless motion generally occurs within two or three hours after the administration of the drug. The sulphate is the most active of these cathartics, and it is an important ingredient of Carlsbad, Marienbad, Franzensbad,

Tarasp, Villacabras and Rubinat Condal waters, and occurs in association with magnesium sulphate in Friedrichshall, Hunyadi Janos, Apenta, Seidlitz, Kissingen, Pullna, Æsculap and Franz Joseph waters. Both the sulphate and phosphate are mild cholagogues, and Carlsbad waters have been shown to increase the amount, as well as the solid constituents, of the bile.

Blood and Kidneys.—On account of the slowness of their absorption phosphate and sulphate have less influence than the corresponding salts of potassium in rendering the blood and urine alkaline and in causing diuresis.

Therapeutics of Sodium Phosphate and Sulphate, and of Potassium and Sodium Tartrate

On account of its nauseous taste, the sulphate is rarely prescribed, except as it occurs in the various aperient mineral waters. The taste may be in some degree disguised by the addition of a few drops of aromatic sulphuric acid, or by giving it in lemonade. In dysentery good results have been obtained from it in daily quantities of 10 gm. (2½ dr.). Its use as an antidote in phenol poisoning has been shown to be without direct effect on the progress of the intoxication. This, it is believed, is due to the fact that phenol does not combine with sulphates, as such, in the body, but with organic sulphur compounds which are only in process of being oxidized to sulphuric acid. Still it is useful after the use of alcohol as an antidote, to empty the intestines. Rochelle salt is employed to a very considerable extent as a **mild saline purgative.** Although much less efficient, it is far less **disagreeable** to take than either magnesium or sodium sulphate, and is especially acceptable in Seidlitz powders, which form an effervescing draught. In small repeated doses it does not purge, and serves to render the urine alkaline. The phosphate is not so powerful a cathartic as the sulphate, but is also less disagreeable, and is used more extensively. Both these salts are often of service in the treatment of gall-stones, probably chiefly by improving the condition of the mucous membrane of the intestine. The phosphate is useful in various affections of the liver, and is of especial value in cirrhosis, if commenced early in the disease and persistently administered. By correcting a catarrhal condition of the duodenum, its persevering employment is often efficacious in

the prevention of biliary calculus. This salt is also useful in catarrhal jaundice. It is, at times, beneficial in the hepatic form of diabetes, and it is of great service, especially when combined with sodium arsenate, in obese subjects when a succession of boils portends the development of diabetes. In administering all saline cathartics it should be borne in mind that they produce their proper effect only when given in solutions of a certain degree of dilution. Often it appears that just in proportion to the dilution of such a salt is its relative efficiency as a purgative, and this is well illustrated in the use of the natural mineral waters, which are purgative in quantities which contain only an inconsiderable proportion of the natural salts. The phosphate has been supposed to be of benefit in nervous diseases, on the theory that these were due to the insufficiency of phosphorus in the brain, but the animal organism is probably unable to form combinations between phosphates and proteids. At the same time some neurologists claim to have obtained good results from the use of sodium phosphate in facial neuralgia, neurasthenia and hysteria. Subcutaneous injections may be employed of a mixture consisting of sodium phosphate, 1, alcohol, 2, and distilled water, 60. Of this 1 mil (15 ♏) is to be injected daily, and the amount gradually increased to 3 mils (45 ♏). While it is believed to have only a pallative effect in organic disorders of nerve centers, this method is reported to have been attended with marked improvement in certain instances of locomotor ataxia.

SODIUM CHLORIDE

For the Preparation of Sodium Chloride *see* p. 64.

Action of Sodium Chloride

Sodium chloride has practically no specific action. Its effects are limited to the alteration in the fluids produced by its excess or deficiency, and they present a typical example of what is known as **salt action.** As its molecular weight is small and as it dissociates readily into its two ions, it possesses great osmotic power. Strong salt solutions, placed in contact with skin or mucous membrane, withdraw fluid from the surface cells, and this, together with the passage of salt into them, causes some irritation. They also withdraw fluid from the red blood-corpuscles, which shrink in size, and

from muscle, the vitality of which is impaired. On the other hand, with very dilute solutions these all become swollen and softened from the absorption of fluid. Salt solutions which are more concentrated than the blood-plasma are called *hypertonic*, those which are weaker than it, *hypotonic*, and those which are of the same osmotic pressure as the plasma, *isotonic*. When two solutions are separated by a semi-permeable membrane, neither of the salts in solution being able to penetrate the membrane, water accumulates on the side of the solution having the highest osmotic pressure. The osmotic pressure of a given substance is proportional to the number of molecules per volume of solution. A 0.7 per cent. solution of sodium chloride is called the **normal** or **physiological saline solution** because it is supposed to be **isotonic** or indifferent to the living tissues. As a matter of fact, however, it is probable that every cell and fluid in the body has its specific osmotic pressure, with a consequent variation in the concentration of the sodium chloride solution isotonic with it. The active tissues of the body contain a very large proportion of water, and physical continuity between these media is established by the inter-cellular and intra-cellular lymph. Experiment has shown that the normal distribution of water between the blood, lymph and solid tissues is maintained through the nicest physiological adjustment, the direct working factor of which is probably the force of **osmosis**. When the blood loses water, this is replaced by fluid drawn from the lymph, which in turn makes good its loss from the solid tissues. When a dilute solution of sodium chloride which has a lower osmotic pressure than the blood is introduced in excess into a vein, the hydræmic plethora thus produced begins at once to diminish, owing to the rapid transudation of the fluid through the capillary walls, of the intestine and peritoneum.

In the mouth and fauces strong solutions of sodium chloride have an astringent action, while in the stomach they may have an emetic effect from the irritation caused by the withdrawal of fluid and the impartation of salt to the mucous cells. They are also capable of exerting a purgative action. A small amount of sodium chloride in the food, by rendering the latter more palatable, no doubt often has the effect of increasing the flow of gastric juice through reflex influence; but stomachic digestion is not always improved by it, since it has been found that even small quantities diminish the acidity of this secretion. Mineral waters in which common salt is the chief

constituent have no direct effect on the secretion, but appear to alter the nutrition of the gastric mucous membrane. Thus it is found that in some individuals the hydrochloric acid is increased by these waters, while in others it is lessened. Hypertonic and isotonic salt solutions are absorbed in the stomach and intestine, as well as hypotonic ones, and in order to explain this it is necessary to assume that there exists a constant natural tendency for fluids and some salts to pass inwards from the lumen of the gastro-intestinal tract. Hypotonic solutions are naturally absorbed rapidly, while isotonic ones are absorbed more slowly, because in this instance the natural flow alone is active. With hypertonic solutions the absorption is still slower, for the reason that the natural flow is at first antagonized by the osmotic pressure-current, which is in the opposite direction. Hence, for a time the fluid in the canal may actually be increased, by the abstraction of liquid from the blood; but, as the absorption of salt is all the while taking place, the concentration of the fluid is gradually reduced until it becomes isotonic, and it is then absorbed. In the serous cavities it is stated that when salt solution is injected, absorption takes place in the same way from the stomach and intestine, except that osmosis plays a more important part than in them. The blood and lymph are in turn affected by the processes occurring in the alimentary canal, and it is established that the absorption of salt, as well as of water, leads to an augmentation of the normal exchange of the two fluids. Again, the changes in the blood and lymph are followed by an increased activity of the excretory organs. The flow of urine is increased to some extent by the absorption of salt solution from the alimentary canal, and to a notable degree by the injection of such a solution into the circulation, and this is believed to be the result of salt-action, and not of any direct effect produced upon the renal cells. The saliva is also increased, partly by a reflex action from the mouth and partly because a portion of the salt is excreted by the salivary glands. While any salt solution causing an acceleration in the movement of the fluids of the body necessarily tends to facilitate the excretion of waste products, the elimination thus caused is much smaller than has generally been supposed, and recent investigations indicate that salt tends to lessen the proteid metabolism through acting directly on the cells. This action is stated to be so slight, however, that the resulting fall in the nitrogen eliminated is concealed by the increase

caused by the more complete flushing. Both sodium chloride and the potassium salt augment the salts of the urine. As sodium chloride is the most important of the mineral constituents of the body, so far as regards its general distribution and the active part which it takes in the internal phenomena of nutrition, the ingestion of an adequate amount of it is essential to the maintenance of health, and the deprivation of it leads to general weakness, œdema and anæmia.

Therapeutics of Sodium Chloride

Locally it is used in solution as a gargle for ordinary sore throat or in atomized solution for subacute and chronic affections of the pharynx and larynx, in douches for the treatment of nasal catarrh and ozæna, as an injection into the vagina and rectum, and as a wash for indolent ulcers, hives and pruritus vulvæ, as well as for the stings and bites of insects. As a rule, the solution used for affections of the mucous membrane should not exceed a strength of 1.20 gm. (20 gr.) to 500 mils. (1 pt.) of water, as stronger solutions are likely to be painful and to aggravate the disease. Rectal injections of strong solutions of salt, which by removing mucus serve to render the bowel unfit for the habitation of the parasite, constitute one of the best methods of treatment for the *Oxyuris vermicularis*. Concentrated hot salt baths are beneficial in chronic rheumatism and sciatica. Sea-bathing, as is well known, has pleasant general stimulating effect, and its beneficial results are largely due to the abundant presence of sodium chloride in the water.

Internally it is used as an **emetic,** and 30 gm. (2 tablespoonfuls) in 250 mils (½ pt.) of tepid water are generally successful in causing a prompt evacuation of the stomach. Its efficiency as an emetic is increased by combining it with mustard water. In poisoning by silver nitrate it arrests the corrosive action by the formation of insoluble silver chloride. Administered in the form of natural mineral waters, in which it is a prominent ingredient, or in carbon dioxide water, it often proves of service in gastric disorders, and especially dyspepsia attended with decomposition of food in the stomach, with resulting flatulence, acidity and pain. Salt meat and other saline articles tend to prevent alcoholic intoxication, and enemata of salt and water are employed with success to rouse drunkards from their lethargy or abate their delirious outbreaks. In conditions where the

body has lost much fluid, as from hæmorrhage and in Asiatic cholera, life has repeatedly been apparently saved by the intravenous injections of solution of salt in distilled or boiled water, with the addition sometimes of a small amount of sodium sulphate or carbonate, calcium chloride, or other alkali; and normal saline solution is now commonly given in this way or by hypodermatoclysis (*see* p. 266), as a substitute for transfusion of blood. This may be prepared by dissolving 4 gm. (60 gr.) of common salt in 500 mils (1 pt.) of boiling water, and allowing the solution to cool at 37.7°C. (100°F.). It is often desirable, however, to use it at a considerably higher temperature than this. Although its content of sodium chloride is higher than that given above the following has been recommended: Sodium chloride, 0.9; calcium chloride, 0.026; potassium chloride, 0.01; distilled water, 99.064. The **physiological solution** of sodium chloride, which is now official, contains 0.085 per cent. of sodium chloride. Salt solution has also been employed in uræmia and similar intoxications, and in such conditions subcutaneous injection is preferred by some. In the event of insane patients refusing to take food, the use of salt solution by hypodermatoclysis has sometimes been found of service, as it has the effect of exciting hunger and thirst. In poisoning by carbon dioxide and by coal gas, good results have been reported from this procedure or the intravenous injection of a salt solution, after a preliminary bleeding. Intestinal lavage with normal saline solution, by means of the rectal irrigator, is almost certain to have a marked **diuretic** effect, as it has been pointed out that the association of action between the lower bowel and the kidneys is such that a movement of the bowels can scarcely take place without simultaneously inducing a urinary flow. It is therefore of great service in various conditions and especially acute nephritis. But in no form of nephritis, if œdema is present, should saline infusions or injections be employed. In colitis, particularly when chronic, medicinal remedies not infrequently fail to complete the cure until supplemented by the local effects of such lavage. The beneficial influence of the enteroclysis may be enhanced by the addition of the fluid of antiseptic and anodyne agents. Auto-infection from retention of putrid contents in the colon may give rise to grave cerebral symptoms, and the same conditions are often met with in cholera infantum; here such **intestinal irrigation** is indicated, both to combat the toxic infection and to secure the beneficial effects of the saline

on the blood, after it has been drained of its salts by the watery evacuations. This procedure may also prove valuable against the toxæmia in fevers, particularly typhoid fever. It is important to remember that sodium chloride may be poisonous in certain conditions. These are its use in too concentrated solutions, whether by injection, intravenously or by hypodermatoclysis. Nausea, vomiting, diarrhœa, maniacal delirium (from sea-water), coma, fever, collapse and death even have been recorded. Crenation of red corpuscles, pulmonary or general œdema, have been noted after large doses of common salt. It is well to adhere in practice to the usual concentration as expressed in the commonly accepted formulas for normal or physiological saline solution.

SODIUM ACETATE

For the Preparations of Sodium Acetate *see* p. 65.

Action and Therapeutics of Sodium Acetate

Its action is the same as potassium acetate, both resembling the chlorides, and therefore owing any effect they possess to the salt-action. In the body, however, they are **oxidized**, with the formation of carbonates, and hence their action before absorption is that of the chloride, and afterwards that of the carbonate. The result is that the alkalinity of the blood and of the urine, as well as the amount of the latter, is increased.

Although it has decided diuretic properties, it is seldom prescribed medicinally. By some, however, it is considered more efficient as a diuretic, as well as milder and less apt to derange the digestion, than potassium acetate. It has been given as an **antacid** in acute rheumatism and as a diuretic in dropsies, and also used, with considerable success, in irritation of the genito-urinary apparatus and in gout.

SODIUM CITRATE

For the Preparations of Sodium Citrate *see* p. 63.

Action and Therapeutics of Sodium Citrate

Through its affinity for calcium and the production of calcium citrate it, will delay or **prevent the coagulation** of the blood and retain

milk in a fluid condition. For this purpose 0.06 gm. (1 gr.) may be added to each 30 mils (ounce) of milk in the feeding of infants. Since it is absorbed with some difficulty, it is a mild purgative, similar in its action to magnesium citrate. The portion which may be absorbed will have some diuretic effect. In typhoid fever, when given in the second or third week with a view of preventing thrombosis the results have not been encouraging. It may be administered where a pleasant saline laxative is required.

AMMONIUM

Ammonia

For the Preparations of Ammonia *see* p. 67.

Action of Ammonia

External.—Free ammonia is intensely irritating, but on the other hand its radicle is so markedly alkaline that it forms salts as stable as those of potassium or sodium. Applied to the skin ammonia solutions of moderate strength are **rubefacient.** Strong solutions cause a burning pain and, if covered, **vesication.** Ammonia differs from the other alkalies in being more volatile, in consequence of which it penetrates more rapidly and deeply. It passes through the *stratum corneum* of the epidermis without dissolving it, and produces blisters. At the same time it is less corrosive than the fixed alkalies, although, if the application is continued, sloughing will result.

Internal. *Eyes, Nose* and *Air Passages.*—Vapor of ammonia, in contact with the eye, causes severe pain and inflammation. When inhaled it is also irritating, occasioning reflex acceleration of the pulse and respiration. If sufficiently concentrated, it is likely to cause spasm of the glottis or such swelling of the mucous membrane of the larynx and trachea as to induce asphyxia.

Stomach.—In the mouth, fauces, œsophagus and stomach concentrated solutions produce corrosions similar in character to those resulting from caustic potash, but as the gas evaporates rapidly from ammonia solutions, some of the vapor generally escapes into the respiratory passages, and in the manner described tends to produce asphyxia which may result very suddenly in death. In dilute solution ammonia acts as a mild gastric stimulant. Like other alkalies,

it renders the gastric juice less acid and tends to liquefy the mucus in the stomach.

Skin, Mucous Membrane, and Salivary Glands.—Ammonia and its salts have considerable effect in increasing the secretions, especially the saliva, mucus and perspiration. The diaphoresis has been attributed to their action on the central nervous system, and the increase in the saliva and mucus to a reflex stimulation from mucous membranes due to a salt action, to direct stimulation of the secreting centers, and to local salt-action upon the secretory cells themselves. The ammonium salts are said to be excreted largely into the mouth by the saliva, as also by the lungs, mainly in the form of the carbonate. In this way the local action is exercised twice, when the salt is applied and when it is excreted, and this excretion as the carbonate also tends to liquefy the mucus on account of its alkaline action.

Blood.—When injected in poisonous quantities it has been found to prevent the blood from taking up oxygen. Having the property of dissolving fibrin, it is believed to diminish the local liability of the blood to coagulate, and also to be capable of dissolving clots, as in instances of thrombosis.

Heart and Circulation.—Upon the circulation ammonia acts as a powerful, but fleeting **stimulant.** When it is inhaled, the irritation of the nasal mucous membrane causes a reflex stimulation of the vaso-motor center, and consequent constriction of the arterioles and **increased blood-pressure.** The cardiac action may be temporarily slowed by inhibitory reflexes. If injected in moderate amounts into the circulation, the blood-pressure rises from the contraction of the peripheral vessels caused by stimulation of the vaso-motor center. The heart itself is sometimes slowed from increased activity of the inhibitory center, and sometimes accelerated; whether in consequence of action on the cardiac muscle or on the acceleration center is not known. The pulse-rate and the pulse-force, as well as the blood-pressure, are usually increased, and the rise in the arterial pressure is followed, if the dose has been sufficiently large, by a decided fall, ending in permanent diastolic arrest of the heart. If by means of intraveous injection the ammonia reaches the heart in large amount in concentrated form, the organ at once ceases to beat, in consequence of paralysis of its muscular walls. Any effect that solutions of ammonia, when taken by the mouth, may have in stimulating cardiac action, is probably not due to a direct influence upon

the heart, but to an action exerted reflexly from the gastric irritation. In confirmation of this opinion is the now generally accepted fact that ammonia is converted into urea by the liver.

Respiration.—From the reflex stimulation of the respiratory centre in the medulla, when ammonia is inhaled, the respiration is at first checked, and then rendered fuller and deeper. So, when the drug is injected subcutaneously or intravenously the respiration often ceases for a moment, and then becomes very much accelerated, while in some instances it is deepened; this increase in respiration being due to **stimulation of the respiratory center.** As to the preliminary pause, it is thought probable that it is due to excessive stimulation of the respiratory centre. The breathing finally stops in respiratory tetanus.

Nervous System and Muscles.—The action on the central nervous system consists of a **stimulation,** especially of the **medulla oblongata** and **spinal cord.** Then, as the stimulation passes downward, the spinal cord is acted on in turn, and the reflexes are exaggerated. When the drug is injected into the circulation, tetanic convulsions may occur, though appearing rather late and they resemble strychnine spasms quite closely. As they persist after division of the cervical cord and destruction of the brain and medulla oblongata, they would appear to be due to changes in the spinal cord such as are observed in poisoning by strychnine. During the convulsions the respiration is arrested and the blood-pressure becomes extremely high. If the amount injected into the circulation be sufficiently large, the stimulation is followed by paralysis of the central nervous system, and death is caused by asphyxia.

Kidneys.—Ammonia differs from the fixed alkalies in not increasing the alkalinity of the blood and in not reducing the acidity of the urine or rendering it alkaline. This is because it is changed to urea in the liver, and is excreted in this form in the urine.

Therapeutics of Ammonia

External.—The stronger water of ammonia is sometimes used as a **rubefacient** and vesicant. This solution, however, will generally be found too strong for use in its undiluted state, and where a prompt and sufficiently powerful counter-irritant effect is indicated, as is sometimes the fact in various neuralgic, gouty, rheumatic, spasmodic and inflammatory affections, it may be combined, in the proportion

of five parts to eight, with a liquid composed of spirit of camphor and oil of rosemary. A convenient method of application is to fill a suitable receptacle with cotton, and, having saturated it with the lotion, press it upon the part. The ammonia is thus prevented from escaping, and a definite boundary given to the action desired. The less diluted mixture will generally produce rubefaction in from one to eight minutes, and vesication in from three to ten minutes. In severe neuralgias the skin may be blistered at points where the affected nerve is found to be painful. Care should always be taken, however, that the application should not be continued too long, as sloughing may then result. Ammonia is not often used for epispastic purposes, as the blisters produced by it are more painful and slower to heal than those of other vesicants. It is especially applicable, however, when vesication is desired in instances of renal disease, in which cantharides is contra-indicated. Ammonia water is an excellent application for the stings and bites of insects. The inhalation of ammonia water is of great value in syncope; held to the nostrils of persons who have fainted, since by its effect on the mucous membrane, it usually produces, through reflex influence, very prompt stimulation of the heart and respiration. In all instances of suspended animation, whether from syncope or asphyxia, it may be employed, but with caution, on account of the possibility of its giving rise to inflammation of the fauces, glottis and larynx. Ammonia is the basis of most of the "smelling salts" in popular use, the ordinary form of which consists of the carbonate reinforced with some of the strong solution of ammonia and flavored with oil of lavender. Ammonia water is much used in liniments, usually combined with olive oil, and also in washes, when well diluted, to prevent the hair from falling out or to stimulate its growth. The early inhalation of dilute vapor of ammonia may perhaps sometimes arrest the development of catarrhal affections of the throat and air-passages, and also prove of service in chronic dryness of the pharynx and chronic hoarseness.

Internal.—In the stomach ammonia in solution acts as an antacid stimulant, and is useful in heart-burn, sick-headache, etc., but in dyspeptic conditions it is used in combination with the carbonate in the aromatic spirit. In sudden paralysis of the heart from chloroform narcosis, poisonous gases, or toxic agents such as hydrocyanic acid, nicotine, etc., or in **collapse from any cause,** it may be intra-

venously injected—4 to 8 mils (1 to 2 fl. dr.) of ammonia water with an equal quantity of water. Injected subcutaneously, it almost invariably produces a slough. Intravenous injections of ammonia are also called for when sudden thrombosis of a large venous trunk occurs, as, for example, in the pulmonary artery, after uterine hæmorrhage. The repetition of the injection should naturally depend on the effects noted, and it is advised that the limit to the amount of ammonia used should be determined by the state of the heart. In chloroform narcosis this procedure not infrequently fails, and the reason for this is believed to be because the heart stops suddenly and completely, so that before the injection can be practiced the cardiac ganglia have entirely ceased to functionate.

TOXICOLOGY

Poisoning by ammonia may take place from swallowing strong solutions or inhaling its fumes. When swallowed it produces marked local irritation and inflammation of the areas of contact and this may go on to ulceration, or, if life be prolonged, to serious cicatrization. After extensive burns death may result preceded by symptoms of shock. Inhalation produces œdema and inflammation of the upper air passages which may cause death from asphyxia. If absorption takes place, convulsions, collapse with coma and asphyxia, and death results from paralysis of the respiratory center. *Treatment.*—Mild acids, as vinegar or lemon juice to neutralize the poison, demulcents and emollients will relieve the pain and inflammation. Plenty of air or inhalations of oxygen will minimize the effects of inhalation. The œdema of the glottis may require tracheotomy or intubation. The systemic affects are best combated by artificial respiration, oxygen, external heat and such other treatment as may be employed for collapse.

AMMONIUM CARBONATE

For the Preparations of Ammonium Carbonate *see* p. 68.

Action of Ammonium Carbonate

The pharmacological effects of the carbonate are similar to those of solutions of ammonia. Although not so corrosive as the latter, when swallowed in sufficient quantity it acts as an irritant poison. Slight gastric irritation is produced by moderate amounts, and nausea and vomiting by larger doses. It has **expectorant** properties of great value, as it not only increases the bronchial mucous secretion and renders it more fluid, but reflexly stimulates the respiratory center in the medulla oblongata. In the urine it is excreted as urea.

Therapeutics of Ammonium Carbonate

The carbonate, either in solution, or in the form of aromatic spirit of ammonia, is given very frequently in **collapse** and heart-failure, or whenever such conditions are threatened. Here the stimulating influence exerted by it is probably a reflex effect resulting from the gastric irritation. When thrown into the circulation, however, either by subcutaneous or intra-venous injection, there can be no question that it has a direct action upon the medullary centers, and thus causes a powerful, though evanescent, stimulation. In less serious depression resulting from various causes, aromatic spirit of ammonia is a favorite remedy, giving a feeling of increased strength, or even of exhilaration, and increasing the warmth of the surface. It is useful as a gastric stimulant and carminative, and is employed especially in instances of headache attended with acidity of the stomach and flatulent eructations, particularly in hysterical women. In nervous headaches, whether attended with nausea or not, it often affords relief. Ammonium carbonate is likely to prove successful in the treatment of delirium tremens when this is associated with cerebral anæmia and weak heart action. It sometimes counteracts even a high degree of alcoholic intoxication, and is serviceable in the dyspepsia of drunkards from its stimulant and antacid properties, as well as its action in dissolving the tenacious mucus coating the stomach. In doses of from 0.30 to 0.60 gm. (5 to 10 gr.), administered with 0.60 mil (10 ♏) of tincture of capsicum in 30 mils (1 fl. oz.) of some bitter infusion, it is very efficient in relieving the sinking sensations and craving for stimulants experienced by subjects of alcoholism. The same amount given with 4 mils (1 fl. dr.) of tincture of hydrastis dissolved in 60 mils (2 oz.) of water is highly commended by experienced drunkards for the morning-after. It is a valuable cardiac and nervous stimulant in syncope, heart-exhaustion, and all adynamic conditions, and may therefore at times be employed with advantage in these forms of pneumonia, scarlet fever, measles, small-pox and erysipelas, as well as in typhus and typhoid fevers. As it is quickly eliminated, it is best given in small doses repeated at short intervals. In pneumonia it has been pointed out that to stimulate the heart merely, when an obstacle exists in the pulmonary circulation, is of doubtful utility but ammonium carbonate, by liquefying the exudation, also relieves obstruc-

tion of the bronchial tubes, and is thus a remedy of great value. In bronchitis and broncho-pneumonia it is often given in association with other expectorants, and is perhaps most used in the treatment of children and old people. On account of its alkalinity, ammonium carbonate should not be prescribed in a mixture with the syrup of squill. It is sometimes used as an emetic, in dose of 2 gm. (30 gr.) for an adult, and is less depressant than many other agents employed for this purpose. In diabetes with marked acidosis, it has been thought to sometimes prove of service, and its use has been strongly recommended in the treatment of cystinuria.

AMMONIUM CHLORIDE

For the Preparations of Ammonium Chloride *see* p. 68.

Action of Ammonium Chloride

As the chloride does not dissociate the ammonia-ion rapidly, it is not caustic, nor even antacid.

Applied locally to mucous membranes, it **stimulates their secretions,** rendering them less tenacious, as well as increasing their amount. Injected into the circulation, it has, like ammonia and its carbonate, a stimulating action on the central nervous system, but when absorbed from the alimentary canal it apparently has no such direct effect, though reflexly it may cause some stimulation. When swallowed in considerable quantity it may induce irritation and vomiting, but only through its action as a salt, and its solutions are rapidly absorbed and permeate the red blood-corpuscles with great facility. It has some action on the liver, and this is suggested by its increasing the excretion of urea by the kidneys. But unlike free ammonia and the carbonate it is not converted into urea by the liver. It appears to have some effect in increasing the urine, as well as the secretion of the salivary and sweat glands.

Therapeutics of Ammonium Chloride

In consequence of its decided action on mucous membranes, ammonium chloride, either in its nascent state, as generated by the action of hydrochloric acid on ammonia, or in the form of an atomized aqueous solution, is largely used by inhalation in pharyngitis, otitis media, laryngitis, bronchitis, etc., and especially when these conditions are chronic. In both acute and chronic pharyn-

gitis and bronchitis it is frequently administered in the form of troches or compressed tablets. It is also a favorite ingredient of **expectorant** mixtures. Combined with potassium iodide, tincture of ipecac, and in the brown mixture (compound mixture of glycyrrhiza), it is regarded as of especial value in acute catarrhal pneumonia. It is sometimes employed with good effect in so-called biliousness, with coated tongue, decreased secretion of the intestinal fluids, scanty, high-colored urine, etc., and in various hepatic affections, such as chronic torpor of the liver, chronic hepatitis, and catarrh of the bile-ducts with jaundice, it is often of great service. In the first stage of cirrhosis it has also been found useful. The disagreeable taste of the drug may be covered to a considerable extent by licorice or by the fluidextract of taraxacum. The former would naturally be preferred as a vehicle for affections of the respiratory apparatus, and the latter in hepatic disorders. Like the other preparations of ammonia, it is employed in acute alcoholism, and 2 gm. (30 gr.) in 250 mils (½ pt.) of water, swallowed at one draught, is sometimes efficient for patients on the verge of delirium tremens. It is also beneficial in some instances of gastric catarrh in adults, and 0.60 gm. (10 gr.), given half an hour before meals, it is asserted, will afford extraordinary relief in painful dyspepsia due to hyperacidity of the stomach. In tropical dysentery good results have been reported from its use. When this remedy is administered in the form of compressed tablets it is advised that a large draught of water or milk be taken simultaneously to protect the stomach. In strong solutions it is useful as a resolvent in contusions, contused and lacerated wounds, sprains, enlarged bursæ and joints, indolent tumors, etc. A solution of 15 gm. (4 dr.) to 500 mils (1 pt.) of water removes the ecchymosis from contusions, and is also applicable to subacute epididymitis. In local inflammations the cold produced by it in dissolving may sometimes be taken advantage of.

AMMONIUM ACETATE

For Preparations of Ammonium Acetate *see* p. 69.

Action of Ammonium Acetate

Locally the acetate acts in the same way as the chloride, but in the tissues it undergoes oxidation and the whole of it is converted into

urea; so that while the urea and the flow of the urine is increased, there is no increase in its ammonia. It causes an increase not only of the solid constituents of the urine, but also of its fluid, and it **stimulates** the secretion of the **skin** as well as that of the **kidneys.**

Therapeutics of Ammonium Acetate

On account of its diaphoretic and diuretic properties, it is sometimes prescribed in **mild fevers.** It was formerly frequently combined with spirit of nitrous ether, and in slight febrile conditions in children is still employed to some extent, thus associated. Solution of ammonium acetate sometimes proves very grateful to fever patients when administered with an equal quantity of carbon dioxide water. In sick headache from 4 to 8 mils (1 to 2 fl. dr.) repeated every hour, is often efficacious, and this remedy may also be used with good results in acute alcoholism. As a diuretic it is employed as an adjuvant in the treatment of scarlatinous dropsy and of chronic Bright's disease. In the latter the solution of iron and ammonium acetate (Basham's mixture), which is palatable, is preferred on account of the iron being useful for the relief of the accompanying anæmia.

LITHIUM

Lithium Carbonate and Citrate

For the Preparations of Lithium Carbonate and Citrate *see* p. 66.

Action of Lithium Carbonate and Citrate

Lithium is believed to possess an action midway between sodium and potassium, but comparatively little is known of the physiological effects of its salts. Injected into mammals they have caused marked weakness, gastric disturbance, diuresis, increasing dyspnœa, fall of temperature, and death, often preceded by convulsions, from arrest of the respiration. It appears to be depressant to the motor nerves, as well as the spinal cord, and to weaken muscular contraction. These salts in medicinal doses rarely give rise to any definite symptoms in man, unless it be an **increased flow of urine,** but large quantities may cause gastric derangement and possibly some muscular twitching. In the body, lithium slightly increases the nitrogen

excretion. The citrate is less disagreeable to the taste and less liable to irritate the stomach, though in occasional instances it produces nausea and vomiting, than the carbonate, but its effects are the same, as the citric acid is destroyed in the system and the lithium carbonate formed is excreted in the urine. Lithium salts are capable of rendering the urine very strongly alkaline.

Therapeutics of Lithium Carbonate and Citrate

Lithium salts are useful alkaline remedies, and are employed in the treatment of rheumatism and gouty affections, especially of a subacute and chronic character. They have been much lauded in the so-called uric acid diathesis, but while outside the body they exhibit great solvent power over uric acid, with which they form a biurate which is more soluble than the corresponding salts of the other alkali metals, it has been pointed out that in the system they have a greater affinity for the acid sodium phosphate in the blood, and practically leave the uric acid to itself. There is unquestionably clinical evidence going to show the beneficial effects of lithium salts in gouty subjects and where there is a tendency to uric acid, sand and gravel; but there is reason to believe that in the body fluid the amount of lithium introduced by ordinary dosage can exercise no solvent influence upon gouty deposits, and it is now the opinion of many that the large amount of water generally taken with these salts has more to do with relieving the conditions in question than the drug itself. Most of the popular lithia waters contain the salts only in minute proportions, and whatever value is to be ascribed to them is no doubt principally due to their effect in dissolving effete materials resulting from imperfect elimination of tissue-waste. Lithium salts are often of service in alkalizing the urine, as well as in increasing its amount, and thus rendering it more dilute. Given as effervescing tablets, each containing 0.30 gm. (5 gr.) dissolved in a glass of water they constitute a very palatable beverage. On the whole, it would appear that their influence is somewhat limited, but that as minor remedies they possess a certain amount of usefulness in gouty patients. In diabetes, where there is a gouty taint, remarkably good results have been claimed from the use of lithium carbonate or citrate with sodium arsenate. Lithium salts in solution applied externally to joints and ulcers, relieve the pain of gouty inflammation and aid the dis-

appearance of deposits, but they would seem to have no effect in preventing the formation of the latter.

MAGNESIUM

Magnesium Sulphate, Carbonate and Oxide

For the Preparations of Magnesium Salts *see* p. 72.

Action of Magnesium Salts

External.—They have no irritant action.

Internal.—When injected intravenously, magnesium produces very much the same effects as potassium, causing paralysis of the heart and central nervous system; but such results are never observed when it is taken by the mouth, as the salts appear to be rapidly excreted by the kidneys. Magnesium oxide and carbonate differ from the other saline cathartics in being very insoluble and in having an alkaline reaction. In the stomach they are partly converted into magnesium chloride, while in the intestine the carbon dioxide present may dissolve a part by forming the bicarbonate. They have a mild purgative action, and at the same time any excessive acidity in the gastro-intestinal tract is overcome by their **alkalinity.** Magnesium sulphate is a much more **powerful cathartic.** When this salt is converted into the bicarbonate in the small intestine, sodium sulphate is formed, and the latter is, of course, also cathartic. Its action is as a rule very satisfactory, large **watery stools** being produced, with but little nausea or griping, and on account of its non-irritating qualities it will often be retained by the stomach when other remedies of its class are rejected. Like other alkalies, magnesium oxide and carbonate are **diuretic** and have the effect of promoting the alkalinity of the blood and urine, but on account of the difficulty with which they are absorbed, this effect is less pronounced than is the fact with sodium and potassium salts. The magnesium of the urine is increased by the administration of these salts, especially if they fail to act on the bowels, but some may perhaps be excreted by the intestine and some even appear in the milk. In some instances the formation of large concretions in the bowel, resulting in obstruction, has been caused by the prolonged use of considerable amounts of magnesium oxide.

Therapeutics of Magnesium Salts

Magnesium sulphate in saturated solution on gauze as a wet compress has been recommended for the pain of neuralgia and of burns; it has given good results, applied locally in the same way, in dermatitis, neuritis, epididymitis and arthritis.

Magnesium oxide and carbonate are used as mild **antacid laxatives.** They are favorite remedies in sick headache, especially when accompanied by acidity and constipation, and in the digestive derangements of children. For the correction of acidity the carbonate is preferable if gastric irritability is present, as the carbon dioxide which is set free by the action of the acid met with in the stomach serves as a local sedative and anodyne. If these preparations do not enter into combination with the gastric acid, it is found that no laxative effect is produced, and under these circumstances the latter can be secured by following their administration with a solution of citric acid. Magnesia magma, generally known as milk of magnesia, in which the magnesium hydroxide, formed by the action of magnesium carbonate upon sodium hydroxide, is in a fine subdivision and suspended in water, and is an excellent method to administer an antacid which also is moderately purgative. Magnesium oxide and carbonate form insoluble compounds with mineral acids, oxalic acid, and the salts of arsenic, copper and mercury, while by their alkaline effect on the contents of the stomach they retard the absorption of alkaloids. They may therefore be used as antidotes to all these substances, but as to secure the desired effect they must be given very freely, their bulk at times makes them objectionable. Magnesia is to be preferred and it is employed in the official arsenic antidote (*see* p. 93). Magnesium sulphate has been used intraspinally in dose of 0.25 gm. (3⅘ gr.) in solution for each 12 kilos (25 lb.) of body-weight, and has given good results in the convulsions of tetanus, eclampsia and strychnine poisoning as well as in the tetany sometimes following parathyroidectomy. It is one of the best and most largely employed of saline cathartics. The commonly accepted view is that, like other purgatives of its class, it acts by abstracting water from the intestinal blood-vessels. It is frequently employed for the varieties of constipation associated with hepatic disorder, gout, or excessive uric acid, and especially in the form of mineral waters. It is an important constituent of most of the natural

aperient waters. Wherever a thorough purgative action is desired, it should be given in concentrated form, so as to make its solution of as high a percentage as possible, and in instances of dropsy 60 gm. (2 oz.) should be taken before breakfast, in as little water as will dissolve the salt. The efficiency of the drug is greater if the amount prescribed is administered in divided doses every fifteen minutes until the whole is taken. For **habitual constipation** in those of full habit and active circulation a daily morning dose of a teaspoonful is often a permanently effective remedy, and where constipation, congestion of the pelvic viscera, and anæmia coexist it may be advantageously combined with ferric sulphate, and dilute sulphuric acid. The disagreeable taste of Epsom salt may be very satisfactorily covered by coffee. Magnesium sulphate may be given by the rectum for the double purpose of unloading the bowels and producing a **depletant effect.** It is useful with glycerin in concentrated enema for thorough cleansing of the bowels before surgical operations (Glycerin, 30 mils (1 oz.), in a saturated solution of magnesium sulphate, in hot water, 90 mils (3 oz.), which is allowed to cool). Although theoretically it has been inferred that a saline cathartic injected intravenously or subcutaneously is incapable of causing purgation, practically it is found that such an action is thus produced; so that magnesium sulphate can also be used hypodermatically in dose of 0.20 gm. (3 gr.), which frequently will cause a watery evacuation. In operations during which the abdomen is opened the subsequent intestinal paralysis may be prevented from causing constipation by injecting into the small intestine through a canula 30 mils (1 oz.) of a saturated solution of magnesium sulphate. The wound in the bowel should be closed by a Lembert stitch.

Being non-irritant, magnesium sulphate may be given freely when inflammation is present, and in enteritis and peritonitis it is quite commonly used for its depletant action. In lead poisoning it is of great service, especially if associated with sulphuric acid. In impaction of the cæcum, with resulting typhlitis, it will often liquefy the fæcal masses and deplete the vessels, and thus remove the obstruction without causing any irritation. Among other conditions calling for the use of an active saline cathartic, such as magnesium sulphate, may be mentioned cholæmia, uræmia, œdema of the brain, and increased intra-cranial blood-pressure from whatever cause. The solution of the citrate is a cooling purgative, which

operates mildly. It is very widely employed on account of its acceptability to the stomach and the facility with which it may be taken, and is often especially useful in the treatment of children.

CALCIUM

Prepared Chalk and Precipitated Calcium Carbonate

For the Preparations of Prepared Chalk and Precipitated Calcium Carbonate *see* p. 69.

Action of Prepared Chalk and Precipitated Calcium Carbonate

External.—They are mildly astringent and desiccant.

Internal.—Calcium carbonate is an **antacid,** and **astringent,** though the greater proportion of it taken leaves the body in the stools entirely unabsorbed. Such absorption as occurs has been found to take place in the upper part of the intestine, but the bulk of that which is absorbed appears to be re-excreted into the intestine.

Therapeutics of Prepared Chalk and Precipitated Calcium Carbonate

External.—Prepared chalk is a good **dusting-powder** in moist eczema, intertrigo and hyperidrosis, and is sometimes used as a protective dressing for ulcers and sores. It is largely employed, sometimes alone and sometimes with other substances, as a dentifrice, because of its mechanical action and also on account of its antacid, astringent and sedative effect upon the gums and buccal mucous membrane.

Internal.—Chalk mixture is a useful remedy in **diarrhœa,** especially when the intestinal discharges are acid, and opiates and astringents are frequently added to it. It should generally be preceded by an evacuant to remove undigested food or other irritating substances and it is principally employed for children. Compound chalk powder and mercury with chalk are also used in the treatment of diarrhœa. Calcium carbonate is given as an **antacid** in acid indigestion. Natural mineral waters which contain salts of calcium as prominent constituents, such as those of Contrexeville, Wildungen, Vittel, Clarendon and Waukesha, have gained considerable reputation for the treatment of uric acid gravel and other affections of the urinary system;

but it seems probable that the benefit derived from them is principally due to the large amount of liquid swallowed. They are used in quantities of from 1500 to 3000 mils (3 to 6 pts.) a day, and should be taken between meals in order to avoid indigestion from the excessive amount of fluid.

LIME

For the Preparations of Lime *see* p. 70.

Action of Lime

External.—Lime water, which is mildly astringent, is also slightly caustic, as likewise is the syrup. Slaked lime is a **corrosive** and **disinfectant.** The unslaked lime is changed at once to the hydroxide in the presence of water, but the hydroxide differs from those of the caustic alkalies in being much less soluble. Hence it does not penetrate so deeply or spread so widely.

Internal.—Lime is **antacid** and **astringent.** It has been suggested that its astringent action is probably due to its forming an insoluble compound with proteids, in the same way as tannic acid, or to its being deposited as the carbonate or phosphate, and thus protecting the surface from irritation. It has the effect of allaying vomiting and it causes a subdivision of the coagula formed by milk in the stomach. It acts as an antidote in **poisoning** by zinc chloride, oxalic acid, and mineral acids.

Therapeutics of Lime

External.—As a caustic it is seldom employed alone, but is generally combined with potassium hydroxide, forming Vienna paste, or with sodium hydroxide to form what is known as London paste. Lime water is used as a lotion for foul and gangrenous ulcers and, either alone or combined with glycerin, in the treatment of acute vesicular eczema. It affords marked relief in the **pruritus** in eczema and other inflammatory affections of the skin and the itching experienced by the aged. It is also useful as an injection for thread-worms, leucorrhœa, gleet, and ulcerations of the bladder, and lime liniment is a standard remedy for burns. As the false membranes of diph-

theria, croup, plastic bronchitis, etc., are composed largely of mucus, they may be broken down by alkalies, and for this purpose lime water is quite commonly employed. A lime water spray, produced by the atomizer, may be inhaled by the patient, or the patient may inhale the vapors arising from lime undergoing the process of slaking with water.

Internal.—Lime water is very largely used in the treatment of vomiting, and for this purpose is generally given with milk, in varying proportion. It is constantly added to the milk of infants and invalids, as it prevents the formation of bulky coagula, and milk thus treated is more easily digested and less liable to cause intestinal disturbance. In instances of **acid poisoning** the syrup (Lime, 65; Sugar, 350; water to 1000) should be employed, as lime water contains too little of the base to be of service. Lime is especially valuable in the treatment of oxalic acid poisoning. As an antacid in the stomach it is inferior to many other alkalies, since it tends to delay the evacuation of the contents. Lime water is used as an astringent in diarrhœa, more particularly in children, and when the stomach is irritable. In dyspepsia accompanied with **vomiting** of food, a diet exclusively composed of lime water and milk is often more effectual than any other plan of treatment. It has been claimed that improvement has been observed in instances in which the blood seemed less capable of coagulating than normally—particularly hæmophilia and aneurism—as a result of the use of lime. The urine of persons who take large quantities of lime water is often alkaline, and sometimes ammoniacal. The latter circumstance has been explained as due to the presence of calcium carbamate, which readily undergoes ammoniacal disintegration.

CALCIUM CHLORIDE AND LACTATE

For the Preparations of Calcium Chloride and Lacate *see* p. 71.

Action and Therapeutics of Calcium Chloride and Lactate

Calcium chloride is an irritant and resolvent. It is extremely deliquescent, and its power of absorbing water is utilized for the dehydration of alcohol and of ether and for other purposes. As well as the citrate, the chloride, outside the body, hastens the **coagulation** of the blood and produces a firmer clot.

On account of its solubility in water calcium chloride is readily administered, although the citrate is generally preferred because of its more agreeable taste, and it has been employed in the treatment of chronic bronchitis, pneumonia, and phthisis and has been recommended for gastric catarrh and fermentative dyspepsia. Its most important use is for the **hæmorrhages** of scurvy, hæmophilia, melæna neonatorum, and other conditions in which the coagulability of the blood is distinctly lessened; one daily dose of 2 gm. (30 gr.) is preferable to smaller ones frequently repeated. If maximum doses are administered for several days previously, it is often possible to perform operations upon bleeders. It may be of use in hæmatemesis and hæmoptysis, and, possibly, also for aneurism. Both salts have also been employed in tetany after extirpation of the parathyroids, in **convulsive nervous diseases** like epilepsy, spasmodic conditions as bronchial asthma and in such conditions as urticaria and angioneurotic œdema. It is said to sometimes cause the resolution of glandular swellings and the calcification of tuberculous deposits, and also to be of service in lupus and other skin diseases.

Drugs Acting on the Red Corpuscles

IRON

For the Preparations of Iron and its Salts *see* **p. 89.**

Action of Iron and Its Salts

External.—While the salts of iron and their solutions have no action on the unbroken skin, on the abraded cuticle and on mucous membranes they have a powerful **astringent** effect by reason of their property of precipitating proteids; so that all **albuminous fluids** are **coagulated** by them. In consequence of this action on the blood, as well as their effect on the vessels themselves, by which the caliber of the latter is diminished by the contraction of the coagulated albumin, they tend to arrest hemorrhage, and constitute in fact the most efficient **local hæmostatics.** While, however, some of the iron salts, such as the chloride, the nitrate, and the sulphate, have very marked astringent value, others are practically inert in this respect.

Solutions of both ferrous and ferric salts have more or less **antiseptic, germicidal** and **disinfectant** activity, and since, in addition to arresting putrefaction, they neutralize the sulphur and ammonium compounds given off from decaying matter, they are also **deodorizers.** Ferric oxides, furthermore, have the power of converting oxygen into ozone.

Internal.—*Mouth.*—Most of the preparations of iron have a peculiar astringent taste, known as chalybeate, which is most pronounced in the persalts. The insoluble ones are practically tasteless, although patients frequently believe that they are not, owing to the sensation of grittiness which they produce on contact with the tongue. The **blackening of the teeth** which is liable to result from the use of iron preparations has been supposed to be due to the formation of iron tannate from the tannic acid of the food or from the sulphur present in carious teeth or in the tartar. To avoid this it is advisable to take them through a glass tube and immediately afterward to brush the teeth. The free acid in the tincture of ferric chloride or the acidity of the chloride itself will injure the dental enamel even if diluted with 8 parts of water.

Gastro-intestinal Tract.—In the stomach almost all the iron salts form chlorides to a greater or less extent, and are then changed into albuminates. Ferric chloride is probably the only one of them which does not abstract hydrochloric acid from the gastric juice, and it is believed that to this circumstance that its peculiar value as a chalybeate remedy is due. Inorganic salts, if taken in sufficient quantity, act as gastro-intestinal irritants, causing pain and discomfort, with nausea and vomiting, and sometimes purging. The more strongly acid ones have a more or less marked **caustic** effect upon the stomach, in consequence of the acid liberated after the formation of chlorides, and this is the fact even with preparations of ferric chloride, which always contain free acid. Hence those preparations which are not at all or but slightly acid, such as reduced iron and ferrous carbonate, do not as a rule cause digestive trouble, though they are generally not so efficient as the stronger preparations. However, this free acid may be neutralized by the addition of sodium bicarbonate, so that the tincture of ferric chloride will be acid only so far as the basic ferric chloride has an acid reaction; nor does this neutralization impair its therapeutic properties, for hydrochloric acid is added to it in the stomach. As ferric chloride is strongly astringent, most iron

salts have an astringent action on the stomach, the degree of astringency depending upon the amount of the chloride which is formed from the gastric juice or is otherwise present. In the duodenum it is believed that the iron compounds, having been changed from chlorides into albuminates in the stomach, may in part be absorbed in solution, or precipitated and taken up as solids by the epithelial cells and the leucocytes, while the greater part is carried on into the lower parts of the intestine. Under medicinal doses the secretions of the alimentary canal show a tendency to diminish, with the production of constipation, with hard, dry stools, while the fæces are blackened from the formation of ferrous sulphide and tannate.

Absorption and Excretion.—It seems to be well established that inorganic iron salts, as well as the organic, are absorbed by the intestine. While authorities differ as to whether organic iron given by the mouth increases the amount of iron in the urine or not, the preponderance of evidence is to the effect that the quantity which is normally excreted in the urine (0.5 to 1.5 mg.) is not affected by the internal administration of either the organic or inorganic preparations. Hence the fact that an iron salt given by the mouth does not increase the urinary iron affords no ground for the assumption that it has not been absorbed. Neither does the iron absorbed increase the amount of iron in the bile or other excretions. The results of experimental researches would seem to indicate that the small part of the iron which, in the duodenum is absorbed by the epithelium and leucocytes, passes through the lymph channels to the mesenteric glands, and thence through the thoracic duct to the blood-vessels. It is then deposited in the spleen, where it may undergo some changes in form; later it is taken up by the blood and deposited in the liver and perhaps in the bone marrow. Where the supply of iron has been inadequate for the formation of hæmoglobin, it is thought that the originally inorganic iron is probably worked into higher forms, and eventually into hæmoglobin in the liver. When there is no such deficiency, however, the liver slowly yields its store of iron to the blood, which carries it to the cæcum and large intestine, by the epithelium of which it is finally excreted. Iron is normally present in all the tissues and secretions, but the greater portion of the total quantity in the body (estimated to be about 2.5 to 3.5 gm. (40 to 55 gr.) in a healthy adult), is to be found in the blood as hæmo-

globin. While some 0.0054 to 0.0108 gm. (1/12 to 1/6 gr.) of iron is taken in the food *per diem*, about the same amount is excreted, chiefly in the fæces and to a much smaller extent in the urine. Any excess of elimination following subcutaneous injection or excessive absorption from the intestine, it may be noted, takes place through the intestinal mucous membrane.

Blood.—It is open to question whether an increase in the number of red blood-corpuscles, or any other especial effect on the blood, is caused by the administration of iron in health. In many instances of anæmia, however, and particularly of chlorosis, the remedy has the effect of rapidly increasing both the number of these corpuscles and the amount of hæmoglobin in the blood. Iron is therefore said to be a **hæmatinic**, and as an improvement in the quality of the blood results in an improvement in the functions of the various organs of the body, it is also regarded as a **tonic**. Although inorganic iron follows the same course in the tissues as food-iron, in the treatment of anæmic conditions it may sometimes have a much more satisfactory effect than the latter. Thus, it has been pointed out that food-iron is always accompanied by a large amount of colloid material, which may materially delay its absorption, especially as it seems absorbable in only a very small part of the alimentary tract, the duodenum; inorganic iron on the other hand is much less completely enveloped and may be more easily absorbed. Moreover, the iron preparations are used in much larger amounts than the food-iron, since to obtain the same effect from the latter it would be necessary to give more of them than could be digested. Accordingly, certain instances of chlorosis are met with in which little or no improvement seems to result from the use of foods containing iron, but which recover rapidly under the use of inorganic iron.

General Symptoms.—The general effects of iron upon the system, it has been found, can be obtained only by the intravenous injection of double salts, like sodio-ferric tartrate, which do not coagulate the blood and at the same time are capable of freeing the iron-ion in the tissues. From the results of experimentation it would appear that iron, like the other heavy metals, has a specific **irritant** effect on the gastro-intestinal mucous membrane, and to a less extent on the kidney. It also **depresses** the **central nervous system**, though how far this is the result of direct action and how far it is secondary to its effects in the alimentary canal is as yet unknown. The heart

is apparently but little affected, though toward the end a rapid fall of blood-pressure is noticed. Post-mortem there is found swelling and congestion of the mucous membrane of the stomach and intestine, with numerous small blood extravasations in many instances.

Remote Effects.—In addition to the improvement of the general health in anæmic subjects derived from the continued administration of iron, it has been thought that this agent has a direct effect on the kidneys, as a mild diuretic, as well as upon the menstrual function. More oxygen is carried to all the tissues, however, and it is possible that these supposed specific effects, which are not of a marked character, are simply the result of the benefit from the remedy in which the whole body shares. The continued use of ferruginous preparations is liable to interfere with the digestion, and may produce gastric oppression, and even nausea and vomiting. In addition, they may give rise to acne, and in rare instances to symptoms of plethora and vascular excitement, with possibly hæmorrhages from the mucous membranes. Exceptionally also they may induce irritation of the kidneys, while in gouty subjects iron is apt to be badly borne. In general, the ferrous salts are likely to produce less disturbance in the system than the ferric ones, and the preparations which are best tolerated are reduced iron, and the phosphate.

Therapeutics of Iron and its Salts

External.—Ferric sulphate, known as copperas, is a cheap and fairly effective disinfectant for sinks, cesspools or latrines. The solution of ferric subsulphate (Monsel's solution) and solutions of the sulphate and chloride have long been held in repute as local **hæmostatics,** the special method of application depending on the part where the hæmorrhage occurs. These preparations, however, form very disagreeable clots, which readily decompose and give rise to septic infection. The astringent salts of iron are not to be recommended in either superficial or deep wounds, where the hæmorrhage can usually be controlled by properly applied pressure. As an astringent for painting on the parts in pharyngitis or tonsillitis the solution of ferric chloride, diluted with an equal quantity of water, is of service, or a solution of 1 part of ferric chloride in 4 of glycerin may be used. The tincture of ferric chloride has been highly recommended

as a local application to the throat in diphtheria, and in erysipelas is sometimes painted over the inflamed surface.

Internal.—*Gastro-intestinal Tract.*—In hæmorrhage of the stomach, from whatever cause, the astringent preparations may often be employed with advantage. If the bleeding is profuse, 4 mils (1 fl. dr.) of the solution of ferric chloride, with the same quantity of glycerin to facilitate swallowing, should be given every hour or oftener; but such large quantities are not required in milder instances. Intestinal hæmorrhage may also be treated in the same way, though the success of the remedy will depend largely on the location of the trouble.

It is a common practice to counteract the tendency of the salts of iron to cause constipation by combining purgatives with them, but this method interferes with the time during which iron remains in the intestines, and it is better to administer the laxative separately, so that the dose can be regulated according to circumstances. However, the constipating effeet of iron salts is no doubt often much exaggerated.

Thread-worms may be killed by a rectal injection of 4 mils (1 fl. dr.) of the tincture of ferric chloride in 250 mils (½ pt.) of water, with the patient in the knee-chest position.

One of the most efficient means of treating **arsenical poisoning** is by ferric hydroxide with magnesium oxide (*see* p. 93). It should be given in large doses and frequently repeated. It is not necessary to wash out the magnesium sulphate, which is formed. Another arsenic antidote is prepared by mixing together 90 mils (3 fl. oz.) of solution of ferrous sulphate and 30 gm. (1 oz.) of sodium carbonate diluted with water, and of this, 15 mils (½ fl. oz.) should be given at short intervals. The insoluble arsenite which is formed in the body may be gotten rid of by a large dose of some simple purgative, such as magnesium sulphate. Sometimes ferric hydroxide (not official), without the magnesium sulphate is administered in large doses; in this instance the stomach must be washed immediately.

Ferruginous preparations are often administered with advantage for the purpose of improving the appetite and digestion, and it is held by some that the chief use of iron as a remedy, even in anæmia, is to promote the digestive function. To aid appetite and digestion, ferrous sulphate will usually be found the most serviceable preparation.

Blood.—As has been stated, the administration of iron in **anæmia**, and especially **chlorosis**, often rapidly increases the amount of hæmoglobin and the number of red corpuscles. It is to be noted, however, that it is useless in pernicious anæmia and of little value, if any, in the anæmia of leukæmia, exophthalmic goitre, and Hodgkin's disease. In common forms of anæmia which are secondary to some special cause, such as hæmorrhage, lead poisoning, malaria, scurvy, etc., the removal of the cause is essential to recovery, but the use of iron salts is often of great service in aiding the latter. It has frequently been observed that iron has very little, if any, beneficial effect upon anæmic patients when it does not increase the desire for food and the ability to digest it, and in the anæmic condition, therefore, ferruginous preparations should be given not only for the purpose of restoring the quantity of the elements in which the blood is deficient, but also to increase the energy of the primary assimilation. To secure the latter object, increasing quantities of the more active astringent salts, especially the sulphate and the chloride, are best. Large doses of these are frequently well borne, though it is worth noting that considerable amounts of the sulphate have been known to occasion obstruction of the bowels. When they produce any untoward effects they should be replaced by other preparations, preference being given to the most astringent ones which will be tolerated by the stomach. The styptic taste of the astringent compounds may be concealed by administering them with 4 mils (1 fl. dr.) of glycerin, which also has the effect of reducing some of the ferric to a ferrous salt, and this substance is frequently added to the tincture of ferric chloride. To restore the amount of hæmoglobin and the number of red corpuscles, small doses of reduced iron or of the carbonate, or some one of the combinations with vegetable acids, are usually the most serviceable. As the scale preparations, iron and ammonium citrate, iron and quinine citrate, or iron phosphate, rarely disagree, they are much used for patients with weak digestion, and small doses can generally be continued for an indefinite period. Red wines and the natural chalybeate waters, such as those of La Bourboule, Levico, Flitwick and of the Columbian Spring at Saratoga, may also prove useful. The numerous other symptoms, besides dyspepsia, which are dependent upon anæmic conditions, such as constipation, neuralgia, amenorrhœa, etc., are naturally improved by the treatment of the anæmia with iron. In chlorosis better results are often obtained from combinations of iron

with strychnine or arsenic than from iron alone. The syrup of iron, quinine and strychnine phosphates (Easton's syrup) is much employed in convalescence after serious illness and in anæmia and chlorosis generally, although no longer official. Good results have sometimes been claimed from ferrous iodide in instances of rheumatoid arthritis, and this preparation is very largely used for rhachitic and scrofulous children, especially in association with cod liver oil. The tincture of ferric chloride, in doses of 1.20 mils (20 ♏), sometimes as often as every hour, has proved beneficial in diphtheria and other severe diseases affecting the throat, and this is a favorite remedy in erysipelas. As the administration of iron tends to elevate the temperature in the sick, however, ferruginous preparations are generally inadvisable in other febrile diseases. Some individuals cannot take iron at all, on account of the severe headache or indigestion which it induces. Iron should always be administered after meals, except when given for follicular tonsillitis, diphtheria, erysipelas, gastric hæmorrhage, or arsenical poisoning.

Kidneys.—It would seem that iron probably has some specific action on the kidney, although its diuretic effect is comparatively slight. In Bright's disease the tincture of ferric chloride is constantly resorted to, both for its tonic and diuretic properties. The solution of iron and ammonium acetate (Basham's mixture), an elegant preparation which is useful as a diaphoretic as well as a diuretic, has long been a favorite prescription in the anæmia of both acute and chronic parenchymatous nephritis.

The Different Preparations of Iron.—While many of these are quite strongly astringent, others are practically non-astringent. There are some, for example, the iodide, the phosphate, the iron and quinine citrate, and the iron and strychnine citrate, in which the drugs with which the iron is combined increase their value and give them special applications. Ferric phosphate, which always contains some free phosphoric acid, is a reliable hæmatinic, and is a very palatable preparation. It has been largely used for children, and especially in rickets, under the idea that the phosphorus in it would promote the growth of bones. Although in ferrous iodide the proportion of iron to iodine is small, it is a very useful preparation, but it is especially liable to injure the teeth. The iron and quinine citrate is a favorite mild preparation for slight anæmias, but must not be prescribed with alkalies, as they precipitate the quinine.

ARSENIC

Arsenical Compounds

For the Preparations of Arsenical Compounds *see* p. 45.

Action of Arsenical Compounds

External.—Arsenic trioxide has no effect on the unbroken skin, unless it is repeatedly applied or allowed to remain in contact with it for some time, when it may occasion redness or eruptions of various kinds. Upon denuded surfaces and mucous membrane it has a considerable though slow and **painful caustic action.** It does not precipitate protoplasm to form an albuminate but slowly acts to produce inflammation with destruction of tissue, sloughing and ulceration. When used to destroy nerves in teeth, it accomplishes this by exciting inflammation which causes necrosis by abolishing the blood-supply. It acts much more energetically upon the higher than upon the lower organisms, and is not therefore of value as a germicide. While arsenic is toxic to all animals having a central nervous system, it is not so to all lower organisms, and hence cannot be regarded as a general protoplasmic poison. It has the property of preserving animal tissue almost indefinitely.

Internal.—*Alimentary Canal.*—Toxic doses of arsenical preparations produce an acute **gastro-enteritis.** How far this is due to local action is now considered somewhat uncertain, because these symptoms appear so late that it would appear to be after absorption. As the caustic action occurs but slowly, the post-mortem findings show that the corrosion is seldom extensive. Moreover, it has been found that the gastro-enteritis may be obtained with equal facility by injecting arsenic into the circulation. From the fact that under these circumstances some arsenic is excreted into the alimentary canal there may no doubt be some local action, but it is held that the quantity thus excreted is quite insufficient to account for the symptoms. Still further, it is known that arsenical compounds do not, like the corrosive poisons, change proteids in solution. The action of arsenic on the alimentary canal cannot therefore be regarded as due to any ordinary form of corrosion. No matter how it is introduced into the system, the **first** and most **marked effects** are observed in the **intestine.** In consequence of the capillary paralysis produced by the

drug there results an exudation, which, having caused the throwing off of the epithelium in shreds, is poured out, when it becomes in a great part coagulated. The epithelial coat of the intestine is found to have undergone fatty degeneration, and the degenerated epithelium sometimes closely resembles false membrane. The effect of this action is to set up a diarrhœa with stools having a "rice water" appearance, due to the shreds of mucous membrane and coagulated exudation which characterize them. Attention has been called to the fact that this condition is exactly the same as that of Asiatic cholera, so that without a history or the presence of other symptoms it is impossible to distinguish between the two except by chemical and bacteriological examination of the dejecta. In exceptional instances the dilatation of the capillaries caused is so extreme that they become ruptured, and there result ecchymoses upon the mucous membrane, or even hæmorrhage into the intestine or stomach, with bloody stools or vomiting. In therapeutic doses arsenic acts as a **gastric stimulant,** the dilatation of the vessels causing an increased flow of gastric juice; and in the same way the secretions of the duodenum are stimulated. It both increases the appetite and promotes digestion, and its specific action on the epithelium is no doubt concerned in the production of this effect.

Blood-vessels and Circulation.—It is now believed by many that capillary paralysis explains the whole course of the toxic action of the drug; the phenomena noted resembling those produced by an irritant inflammation, one of the essential features of which is increased permeability of the capillaries. This is shown by the œdema about the eyes or general œdema, by the nausea, vomiting and diarrhœa. In arsenical poisoning there is an early and pronounced **fall of blood-pressure,** and this has been demonstrated to be almost entirely vascular in origin. The vascular paralysis occasioned is mainly peripheral, and as the arterioles are found to be still capable of contracting, it is assumed that the structures beyond them, namely the capillaries, which moreover, are known to have become more permeable, are the seat of the paralysis. In addition, however, arsenic has some direct action upon the heart, paralyzing its rhythmic power and also depressing its contractility. In accounting for the fall of blood-pressure, it is explained that the vaso-motor center and later the splanchnic nerves lose their control over the vessels. The dilatation of the mesenteric vessels leads to very marked congestion of the stomach

and intestine, and, along with the lessened efficiency of the heart, reduces the blood-pressure. It would seem, therefore, that arsenic is poisonous chiefly from its depressant action on the vessels of the splanchnic area.

Blood.—Some have found that in the normal subject it diminishes the number of the red corpuscles, but does not alter the total hæmoglobin of the blood. Others find the number of blood-cells and percentage of hæmoglobin unaltered by arsenic in normal animals, but describe the bone-marrow as evidently in a state of unusual activity, indicated by its increased vascularity, greater number of leucocytes, lessened fat-cells, with but little change in erythrocytes. In pernicious anæmia it has been observed that arsenic increased the number of the newly formed red corpuscles, but that of more mature ones was diminished. While the action of arsenic is still obscure, it may be stated that the amount of hæmoglobin does not seem to be affected by it, and that in certain diseases in which deficiency of the red corpuscles is a prominent symptom its administration is known to be capable of indirectly increasing their number, while in chlorosis and in health it apparently does not do so. In conditions of general impaired health any improvement in the blood under its use has by many been attributed to improved appetite and increased nutritional activity.

Respiration.—The respiration is temporarily accelerated by the intravenous injection of arsenic. In instances of poisoning in man it is only late that it is seriously affected, but it ceases before the heart; the failure of respiration is thought to be due to exhaustion and low blood-pressure, rather than to any specific action on the respiratory center.

Nervous System.—In chronic poisoning, as well as after a single large but not immediately fatal dose, lesions have sometimes been observed in either the spinal cord or the peripheral nerves.

Absorption and Excretion.—Arsenic is taken into the blood with great facility, and that absorption may take place even from the unbroken skin is shown by the fact that instances of poisoning occur from the use of cosmetic preparations containing the drug. It is very slowly excreted in the urine, fæces, sweat, and all the other excretions, though chiefly by the kidney. It is stored in all the organs; some authorities stating that it is found in largest quantity in the liver, while others deny this. By means of the placental circulation

it may also pass from the mother to the fœtus. A minute amount of arsenic is normally present in the thyroid and thymus glands, the brain, and the skin in man, but none is found in the liver.

Owing to its more intense action on the alimentary canal, the effect of arsenic on metabolism is not so liable to be noted as in the use of phosphorus, but it is very much the same. While the nitrogen of the urine is considerably increased, it is somewhat uncertain whether this is to be attributed to an increase in the urea or of other nitrogenous substances. The ammonia seems to be increased, while the glycogen in the liver disappears entirely, and the liver is apparently incapable of forming it from the sugar of the food. The **fatty degeneration** which characterizes its action on the gastric and intestinal epithelium is also found in the liver and kidney, the muscle-cells of the heart, the blood-vessels and striated muscles, and the lining membrane of the alveoli of the lungs. While arsenic lessens the oxidation of the tissues and causes fatty degeneration of the cells of various organs, it seems probable that it may also increase the waste of proteids of the body directly, though the increase in the nitrogen of the urine may possibly be secondary to the other features. The fatty degeneration which occurs may have the same results as in phosphorus poisoning. The liver is found to be somewhat enlarged, while the pressure on the bile ducts prevents the escape of bile into the intestine. Jaundice, however, is but rarely a very marked feature of arsenical poisoning, and may be entirely absent. The improvement in nutrition under arsenic in doses insufficient to induce chronic poisoning is not well understood, though it may be that more of the food is utilized by the digestive apparatus, while at the same time less proteid is decomposed by the tissues. While it cannot be regarded at present that the effects of arsenic on the nutrition are definitely established, it is a recognized fact that as long as the drug does not interfere with digestion and absorption, it increases the excretion of nitrogen. Under these circumstances it also causes increased deposition of fat. In the mountainous districts of Styria many of the inhabitants regularly eat white arsenic with the result of an increase in appetite, weight and strength and an improvement in the complexion. They gradually accustom themselves to use quantities which would prove fatal to ordinary individuals. Usually it is said, large doses, 0.35 gm. (6 gr.), are taken by them once or twice a week, and no fluid is swallowed for some time afterwards,

so that some of the poison may pass through the bowel unabsorbed, although it has been claimed that a large amount of arsenic has been found in the urine. It is said that this practice stimulates the sexual appetite and produces a feeling of strength and physical satisfaction. These Styrian peasants generally live to old age, and no toxic symptoms are observed in them. On the other hand, the miners of Reichenstein, who are constantly exposed to arsenic, as it is contained in large quantities in the ore, are short-lived. They are said to be subject in childhood to rickets and in adult life to dropsies and respiratory diseases while they offer little resistance to microbial infection and frequently present the cutaneous and nervous symptoms of arsenical poisoning. A characteristic feature of the continued use of arsenic in many instances is the imparting to the breath and sweat of an odor like that of garlic. The excretion of arsenic takes place so slowly that the drug may be discovered in the urine months after the last dose has been taken, and it is well known that arsenic may be found many years after death in the bodies of those who have taken it during life. Even in toxic doses, however, it is not always capable of preserving the body from putrefaction, since in the intestines of persons who have been poisoned with arsenic trioxide, examined some months after death, the poison has been found in the state of arsenic sulphide, into which it has been converted by the hydrogen sulphide developed by the putrefactive process taking place in the bowel.

Untoward Effects.—In very susceptible persons there have occasionally been noticed, from the use of medicinal doses, certain effects which differ from the ordinary symptoms of chronic or arsenical poisoning. Among them may be mentioned restlessness, headache, alopecia circumscripta, bronchitis and hoarseness; more rarely, herpes zoster, epistaxis, amblyopia, and anaphrodisia.

Therapeutics of Arsenical Compounds

External.—Arsenic trioxide, either pure or as a paste, was formerly used as a **caustic** for destroying epitheliomata and superficial growths of various kinds. The desired result is usually accomplished but the process is slow and exceedingly painful. Marsden's paste consists of arsenic trioxide, 1; powdered acacia, 2 parts. Unless it is used in sufficient strength to make the mass of dead tissue slough out

quickly, there is danger of the patient becoming poisoned, as the arsenic is rapidly absorbed. Arsenous iodide in ointment (1 to 12) has been found to be a valuable stimulating application in chronic dry eczema. For lupus the ointment may be made stronger, or may be combined with mercuric chloride. Mercurial ointment containing from 5 to 10 per cent. of arsenic has been advised for warts. Arsenic trioxide is now much employed for destroying the nerves of teeth. As this requires several days, it illustrates the slowness of the corrosive action of arsenic.

One of the most general applications of the drug is in the treatment of **diseases of the skin.** As it exerts its influence chiefly upon the epidermis, its action being upon nutrition through the nerves, diseases affecting the more superficial strata of the integument are most amenable to it, while it produces a less marked effect upon those having their seat in the deeper structures. It should not be employed when there is great heat, burning, intense itching, or rapid cell-change, and should therefore rarely be prescribed in the acute inflammatory stage of any cutaneous affection. It is of great value in many instances of psoriasis, in certain varieties of eczema, especially in chronic squamous and papular forms of the disease, in acne of the small papular variety, especially in neurotic individuals, in certain glandular hypersecretory diseases of neurotic origin, such as seborrhœa and hyperidrosis, in lichen, and in pemphigus. It should be avoided in acute eczema unless the patient is distinctly neurotic. It is sometimes of service in chronic urticaria, and also in morphœa, alopecia circumscripta, and other atrophic diseases. Dermatologists hold that in all diseases of the skin, before arsenic is prescribed, the digestive tract should be carefully investigated, and if any abnormal condition is shown, that this should be rectified.

Internal.—*Alimentary Canal.*—A course of arsenical treatment should always be commenced with small doses; for instance, 0.20 mil (3 ♏) of the solution of potassium arsenite or 0.001 gm. ($\frac{1}{60}$ gr.) of arsenic trioxide in pill or tablet. The dose should usually then be gradually increased. In this way the gastric pain, nausea, diarrhœa and other symptoms of poisoning which the drug is liable to produce may be avoided. Another precaution which should commonly be observed is to administer arsenic immediately after eating, in order that it may be diluted by the contents of a full stomach. When the dose used is minute, however, it is often best to give it before

meals. As a rule, children bear arsenic well, while the aged do not. As arsenic increases the appetite, it is useful as a tonic in many conditions, and it is also found of service in some forms of dyspepsia. Small doses sometimes check vomiting, and especially that variety in which there is simple regurgitation of the food. The solution of potassium arsenite, in doses of 0.06 mil (1 ♏) before each meal proves efficient in some instances of the vomiting of pregnancy, as well as in the vomiting of chronic gastric catarrh, especially the alcoholic form. It is also beneficial, given in the same way, in what is known as irritative dyspepsia, which is characterized by a red and pointed tongue, poor appetite, and distress after meals, the presence of the food causing intestinal pain, and the desire to go to stool. Arsenic in these small doses is furthermore of service in chronic gastric ulcer and also in cancer of the stomach, whsre it diminishes the pain and checks the vomiting; while gastrodynia and enteralgia, when idiopathic, are often promptly relieved by it. In the treatment of stomach disorders it must be borne in mind that only small doses are admissible, since larger ones will serve to irritate the mucous membrane, and thus defeat the end in view. Occasionally it will be found that arsenic is capable of controlling diarrhœa, especially that form dependent upon an intolerance of the presence of food, where the undigested aliment is evacuated soon after it is swallowed. Chronic diarrhœa and dysentery, particularly when due to malarial cachexia, may also often be greatly benefited by it. In instances of constipation where there is deficient intestinal secretion, with dry fæces, it sometimes acts well. It has proved to be of service in catarrhal jaundice, and is especially recommended when the disturbance is of malarial origin.

Remote Effects.—Arsenic is used to some extent in the treatment of diseases of the blood as anæmia, and especially in diseases of the blood-making organs which is designated as **primary anæmia**, including leukæmia, exophthalmic goiter, Hodgkin's disease, and pernicious anæmia. In chlorosis as well as in instances of anæmia, where iron disagrees with the patient or proves unsuccessful, it is considered by some a most valuable agent. In these disorders the efficiency of iron is at times much increased by the addition of arsenic. Although much inferior to that drug, it is next to quinine the most efficient remedy in **malarial injection** which we possess, especially in chronic infections. It is also of service, though distinctly of less value

than quinine, in various other affections when of malarial origin, such as hemicrania and other neuralgias. As a prophylactic against malaria some of the observations apparently indicate that arsenic is superior even to quinine. In a considerable number of nervous conditions, whether there is a malarial taint present or not, it is of value. Among these may be mentioned cerebral congestion, melancholia and hypochondriasis of the aged, and especially **chorea.** In the latter it should be given in rapidly increasing doses. In paralysis agitans, as well as in local chorea and histrionic spasm, the subcutaneous injection of Fowler's solution or Pearson's solution of sodium arsenate (*see* pp. 45 and 46) has sometimes proved of great service. Arsenic employed by this method is also an efficient remedy in lymphadenoma and in malarial hypertrophy of the liver and spleen. Used either internally or locally, often by fumigation in the form of arsenical cigarettes, arsenic is useful in chronic bronchitis, **emphysema,** spasmodic asthma, hay asthma, and chronic pneumonia (fibroid phthisis). Arsenous iodide, 0.30 mil (5 ♏), after each meal of a 1 per cent. solution, increased to thrice this quantity, has been found of value in the bronchitis of strumous children. In both acute and chronic coryza the fumes of arsenical cigarettes are of service. Such cigarettes may be made by saturating bibulous paper in a solution of 1 gm. (15 gr.) of potassium arsenate to 30 mils (1 fl. oz.) of water. In dyspnœa from cardiac weakness, especially in elderly persons, arsenic is apt to afford relief, and attacks of angina pectoris may sometimes be lessened or prevented by the persistent use of the drug in the interval. A course of arsenic, especially of the iodide, often has a valuable tonic influence in organic heart disease, and under its use dyspnœa, palpitation, intermittency of the pulse, and œdema improve. It has been found very useful in a certain form of chronic arthritis, in which the joints become stiff and painful in consequence of a peculiar state of the nervous system; the trophic nerves being involved and the condition one allied to neuralgia. As to its value in the variety of so-called chronic rheumatism, which is accompanied by nodosities of the joints or arthritis deformans, authorities differ. It has had some vogue in the treatment of osteo-malacia and rhachitis. By some it is claimed that it is of considerable service in those forms in which potassium iodide is commonly employed, and that it is often advantageous to administer these two remedies alternately for periods of three or four weeks. Arsenic has been employed with good effect in albuminuria

following scarlatina, and also appears to be useful in certain forms of chronic albuminuria. It is thought to be of considerable value in diabetes of hepatic origin. Good results have also been claimed from the persevering use of small doses of arsenic in cirrhosis of the liver, in epithelioma, and in rodent ulcer, while some have believed that it is useful in scirrhus, especially as the disease manifests itself in the stomach, and in retarding the growth of uterine cancer. There appears to be good evidence that arsenic in large doses restrains the growth of sarcomata, particularly of the fusiform-cell variety.

It is sometimes found that syphilitic affections can be better treated by the combination of mercury with arsenic than by mercury alone, and the solution of arsenous and mercuric iodides (Donovan's solution) is especially useful in old syphilitic skin lesions. In syphilis, there is an extensive use of sodium cacodylate, which is readily soluble in water so that it may be administered hypodermatically, and liberates arsenic so slowly that it is less toxic than the inorganic salts of arsenic. In this disease the pharmacopœial dose is generally exceeded; 0.25 to 0.35 gm. (4 to 6 gr.) being administered hypodermatically every four to six days. Certain synthetic compounds of arsenic neither of which is official, dioxydi-amido-arsenobenzol dihydrochloride (Salvarsan, Ehrlich-Hata) in dose of 0.60 gm. (10 gr.) dissolved in 300 mils (10 oz.) of normal saline solution to which about 23 drops of a 15 per cent. solution of sodium hydroxide have been added, and sodium-diamino-dihydroxy-arsenobenzol-methanal sulphoxylate (Neosalvarsan), mixed with one-half of its weight of inert substance, in dose of 0.60 gm. (10 gr.), have yielded brilliant results in early syphilis but the number of fatal results and frequent serious disturbances demand caution in administration. These substances should not be administered to patients suffering from severe forms of the following conditions: non-syphilitic retinitis, cardio-vascular, pulmonary, and non-syphilitic renal diseases nor degeneration of the central nervous system. Infants and young children as well as the aged demand great caution in the use of these remedies.

After extensive use of these remedies particularly of the latter, Neosalvarsan, it seems fair to conclude that in early syphilis the results are brilliant. The results of the Wassermann test show, however, that for reaching the certainty of a complete and lasting cure, it is necessary to employ mercury and the iodides with the same degree of thoroughness as before the introduction of these salts.

In tabes dorsalis, intra-spinal, and in paresis, intra-ventricular injections, both being local applications, are yielding better results than have been obtained by any previous method of treatment. In all patients, however, the real results of treatment must be established by means of the Wassermann test. The organic preparations of arsenic have been employed also in the treatment of trypanosomiasis, relapsing fever, Vincent's angina, pellagra, splenic anæmia and leukæmia with results concerning which a definite opinion cannot be expressed at this time.

Furunculosis may be successfully treated by the persistent use of arsenic, and small doses of it are said to have a curative effect upon warts. Given in association with the bromides, it is useful in lessening or preventing the disfiguring acne which so frequently results from the continued administration of these drugs.

The springs of Levico and La Bourboule contain arsenic trioxide. Strong Levico contains 0.005 gm. (1/12 gr.) of arsenic trioxide and 2 gm. (30 gr.) of iron to 500 mils (1 pt.); weak Levico, 0.0005 gm. (1/120 gr.) and 0.50 gm. (8 gr.) respectively. La Bourboule contains 0.005 gm. (1/12 gr.) of arsenous acid, and a trace of iron, to 500 mils (1 pt.). These waters should always be taken with the meals.

TOXICOLOGY

Acute Poisoning.—Arsenic is used to a very considerable extent for poisonous purposes. The forms most employed are Scheele's and Paris Green (cupric arsenite), and Schweinfurth's Green (a compound of cupric arsenite and arsenate). *Symptoms.*—As the pathology of the effects of arsenical salts in the alimentary canal is practically the same as that of Asiatic cholera, so the symptoms of poisoning by them generally resemble very closely those met with in that disease. Large doses frequently produce no distress for a considerable time, but in the course of half an hour, or perhaps longer, the patient experiences a sense of constriction in the fauces, with dysphagia. About the same time he begins to suffer from slight epigastric pain, which soon becomes extreme, and spreads over the abdomen. It is accompanied with faintness, nausea and excessive vomiting, and later by profuse watery diarrhœa, with tenesmus and intense thirst. The matter vomited and the stools may contain blood, but this is not infrequently absent. The patient also suffers from muscular cramps, headache and dizziness, and gradually sinks into collapse, with coldness of the extremities, pallor, small and feeble pulse, and sighing respiration. This condition passes into one of coma, followed by death, which may or may not be preceded by convulsions. Exceptionally the only symptoms were those of collapse and coma. Death may perhaps occur within twenty-four hours, but more commonly the vital powers are not exhausted

for considerably longer than this, and the patient may live for several days. Not infrequently it is found that he may recover from the acute symptoms only to develop those of chronic arsenical poisoning.

Post-mortem.—The mucous membrane of the gastro-intestinal tract is generally red and swollen, while its epithelial coat in many places can be readily detached and is found to be in a state of fatty degeneration. As a rule, no erosion is observed unless the arsenic has been swallowed in powder-form when, if the latter has remained for some time in contact with the wall of the stomach, there may perhaps be some erosion, as well as more marked congestion, as the result of its local action. In the intestine the swelling and congestion of the mucous membrane is most pronounced around Peyer's patches, and the bowel generally contains a considerable quantity of thin fluid with flakes of membrane, like the rice-water discharges of cholera. Hæmorrhage is only occasionally met with, but in both the stomach and intestine small particles of arsenic are not infrequently observed.

Treatment.—It is important that the stomach should be completely emptied as soon as possible, either by washing it out or the use of emetics (*see* p. 380), choice being made of those least depressing and least irritating. On account of the insolubility of arsenic it is advisable that the stomach washing should be continued for some time. At the same time large quantities of freshly prepared ferric hydroxide with magnesium oxide (*see* p. 93) or ferric hydroxide (not official) should be given at once; if these cannot be obtained, magnesia, preferably light magnesia, shaken up with water. The antidote must be repeated at intervals so long as the acute symptoms continue. If neither magnesia nor the iron preparations are procurable, dependence must be placed on large doses of castor oil, and water. For the collapse, subcutaneous injections of brandy or ether may be given, and warm applications made to the abdomen and extremities.

Chronic Poisoning.—When arsenic is given medicinally, too large doses may induce slight symptoms of poisoning, such as abdominal pain, loss of appetite, nausea, indigestion, mild diarrhœa, puffiness of the eye-lids, injection of the conjunctiva, and watering of the eyes and nose.

Cutaneous eruptions are also sometimes caused, and while these may be due in part to circulatory derangements, they are believed to result chiefly from a direct action of the drug on the skin. They may be erythematous, papular, vesicular or pustular in character, and may be attended with erysipelatous swelling. Herpes zoster, it is said, has been caused by its prolonged administration. As arsenic is very extensively used in the arts, particularly in the manufacture of wall papers and fabrics, accidental poisoning is not infrequent among workers in arsenic and may occur in persons using articles which contain it. The evidence in regard to chronic poisoning from occupancy of rooms decorated with arsenical wall paper is contradictory, but its possibility cannot be denied. Quite as often the poisoning is due to the arsenic which is a contamination of aniline dyes as it is to the arsenical pigments, so that the color should not be depended upon for an opinion, but rather a chemical examination made.

As the arsenical poisoning goes on, a catarrhal condition of the mucous membrane of the nose and throat is developed, with much sneezing and coughing, cutaneous eruptions of various kinds appear, and, in some instances, a curious pigmentation of the skin occurs (arsenic melanosis); while eventually the hair and

nails fall out. Swelling of the liver, with jaundice, is sometimes met with, and the later phases of the disorder are characterized by sensory and motor disturbances in localized areas, generally in the hands and feet, the result of a polyneuritis. There are acute pains and formication in the extremities, followed by sensory paralysis, with symptoms resembling those of locomotor ataxia. This again is succeeded by motor paralysis, which as a rule is confined to the extremities, but may possibly invade the trunk. It is generally symmetrical and the affected muscles, more commonly the extensors than the flexors, atrophy quite rapidly. Herpes of the face or trunk, of nervous origin, is a common symptom. In very prolonged instances the patient may sink into an apathetic, semi-idiotic condition, or may become epileptic. After death from chronic poisoning, in addition to the gastro-intestinal and nervous lesions, there is found fatty degeneration of most of the organs of the body, and particularly of the liver, kidneys, stomach and muscles, including those of the heart.

DIVISION III.—DRUGS ACTING ON THE CARDIAC MECHANISM

While it was formerly supposed that the spontaneous impulses originating in the heart, which normally commence in the sinus venosus and extend downward over the auricle and ventricle to the apex, had their origin in the cardiac ganglia, the real function of these ganglia, which may possibly be a nutritive one, is still practically unknown, and there is now at command considerable evidence to the effect that it is in consequence of impulses originating in themselves that the muscular fibres contract. The contractile function of the muscular fibres is, however, subject to two opposing influences, one that of the accelerator nerve-fibres connected with the sympathetic, which tends to augment it, and the other that of the pneumogastric, or vagus, which tends to inhibit it. In studying the effects of drugs on the heart, therefore, all that we are called upon to consider is their action on the muscular structure of the heart, on the nerve-fibres distributed to it from the vagus and the sympathetic, and on the vagus and accelerator centers in the medulla which are extremely sensitive to afferent impulses conveyed from various parts of the body, as well as from the heart itself. Our knowledge of the action of drugs upon the human heart is necessarily somewhat imperfect, since it is principally derived from laboratory experimentation, in connection with which there are many difficulties and sources of error. Thus, many experiments cannot be satis-

factorily made upon the mammalian heart, and hence the cold-blooded animals have been made use of to a large extent, it is a question how far deductions from these experiments are applicable to the human heart. A uniformity of effect will naturally go far to establish the character of any given action as regards man, but in general we have to depend largely on probabilities in this matter. Attention may here be directed to one point of interest; the action of a large dose of a drug is, as a rule, the opposite of that of a moderate dose.

A. Drugs Acting Upon the Heart Directly.—Our knowledge of these has been derived from the application to the heart of a solution of the drug externally, or by means of a transfusion canula, and by the action of the drug upon the excised heart or section of a heart. Since the apex probably contains no nerves, it is customary to conclude that if a drug has an action on the isolated apex it acts exclusively upon the muscle; but as it is always a difficult matter to decide whether a drug acts upon the muscle fibre itself or upon the fine nerves between the fibres, it will be found advisable to make no attempt to distinguish between these actions. In studying the nervous influences affecting the heart's action much more attention has been paid to the inhibitory or vagus than to the accelerating mechanism. The effect of stimulating the muscle is the same as that of stimulating the accelerator fibres, and consists in an augmentation of either the rate or the force of the beat, or both. On the other hand, stimulation of the vagus fibres or its cardiac terminations may cause a diminution in either the rate or the force of the beat, or both; while the paralyzing of either the accelerator or vagus terminations naturally produces an effect just the opposite to that of their stimulation. As it is very difficult to decide whether drugs act upon the muscle or on the nerve-endings, it will be most convenient to classify those which act locally on the heart, by the effect they produce, without reference to this point.

Drugs increasing the force of the contraction:

(1) **Digitalis.**
(2) **Strophanthus.**
(3) **Squill.**
(4) **Caffeine.**
(5) **Suprarenal gland.**
(6) **Sparteine.**
(7) **Oxygen.**
(8) **Camphor.**

In frogs these drugs, in large doses, always stop the heart systole; in mammals this may be in diastole with some, *e.g.*, digitalis. They all slow the pulse.

Camphor, musk and physostigmine have the same action without the final arrest in systole. The rate of the pulse is not so markedly altered. Pilocarpine slows the pulse rate but does not increase its force.

Drugs the chief action of which is to decrease the force of the contraction, usually with stoppage in diastole:

(1) **Diluted acids.**
(2) **Strong solutions of salts of the alkaline metals.**
(3) **Strong solutions of copper double salts.**
(4) **Strong solutions of zinc double salts.**
(5) **Strong solutions of hydrated chloral.**
(6) **Pilocarpine.**
(7) **Apomorphine.**
(8) **Emetine.**
(9) **Salicylic acid** (large doses).

Drugs an important action of which is to increase the rate of the cardiac beat:

(1) **Atropine.**
(2) **Hyoscyamine.**
(3) **Cocaine.**
(4) **Caffeine.**

Drugs which increase both the force and the number of beats:

(1) **Ammonium salts.**
(2) **Alcohol.**
(3) **Ether.**
(4) **Chloroform.**
(5) **Anæthetics.**
(6) **Arsenical salts.**
(7) **Quinine.**
(8) **Strychnine.**

Drugs which decrease both the force and the number of the beats:

(1) **Aconite.**
(2) **Hydrocyanic acid.**
(3) **Veratrum Viride.**
(4) **Antimony salts.**
(5) **Hydrated Chloral.**

Other drugs possess a similar action but are not ordinarily employed for this purpose as—Ipecac, acetanilid, acetphenetidin, antipyrine, lobelia, and ergot.

B. Drugs Acting on the Vagus Center.—It may be concluded that a drug acts on the vagus center when it is found that while it has the effect of altering the beat of the heart, such alteration may be counteracted either by section of the vagi or by stimulation of the peripheral end of the nerve, if only one of the vagi be cut.

Drugs which stimulate the vagus center: that is slow the pulse, but this disappears on section of the vagi:

(1) **Chloroform.**
(2) **Hydrated Chloral.**
(3) **Aconite.**
(4) **Veratrum Viride.**
(5) **Digitalis.**
(6) **Sparteine.**
(7) **Strophanthus.**
(8) **Oxygen.**
(9) **Squill**
(10) **Staphisagria.**
(11) **Hydrocyanic acid.**
(12) **Atropine.** } (only very early
(13) **Hyoscyamine** } in their action).

Drugs which depress the vagus center: Large doses of the drugs above mentioned, and those which diminish the blood-pressure, such as cocaine, glyceryl nitrate, amyl nitrite, and the other nitrites.

C. Drugs Acting on the Accelerating Center.—So far as known, there are no drugs which have the effect of depressing this. Probably some stimulate it, for their administration renders the pulse still more rapid after the vagi have been cut.

They are—

(1) **Ammonia.** (2) **Caffeine.** (3) **Apomorphine hydrochloride.**

Any drug which makes the blood venous will produce the same effect.

Therapeutics.—The drugs most used for their action on the heart are digitalis, strophanthus, ammonium salts, sparteine, squill, caffeine, strychnine, alcohol, ether, belladonna, chloroform, aconite, antimony and hydrocyanic acid. The various indications for which they may be administered will be mentioned under each drug.

Drugs Acting Upon the Heart Directly

DIGITALIS

For the Preparations of Digitalis *see* p. 135.

Action of Digitalis

External.—Its principal local action is on the mucous membranes, where the primary irritation caused by it is not infrequently followed by paralysis of the nerve endings.

Internal.—*Gastro-intestinal Tract.*—It causes **gastro-intestinal irritation,** and in large doses gives rise to gastritis and purging, with green stools. There is some ground for supposing that these disturbances are in part at least of **central origin.** Its absorption from the intestinal tract is slow and its diffusion through the tissues is uncertain so that systemic effects may not be expected for hours and sometimes for days.

Blood.—It has no appreciable effect upon the blood.

Heart.—Digitalis has a pronounced effect upon the heart, affecting its rate and rhythm. This is due principally to its **direct action** on the **cardiac muscle,** influencing its tonicity, contractility and irritability, and the conductivity of the auriculo-ventricular bundle, and indirectly its nutrition, but also, in part, to **stimulation**

of the **vagus** apparatus, both in the medulla and peripherally, producing loss of tonicity, slowing, arrhythmia or in extreme instances a blocking of the impulses in their transmission from auricle to ventricle. Applied locally to the heart, digitalis is capable of causing tonic contraction of the organ and an increase of its force even when applied to the isolated apex, in which no nerves are believed to exist.

The influence which digitalis exerts may be divided into three stages. In the first, or therapeutic stage, the **rhythm** of the heart is markedly **slowed,** and the ventricles, emptying themselves more thoroughly than under normal conditions, become diminished in size. As the contraction of the ventricle is more complete, the blood is expelled into the vessels under greater pressure. Relaxation of the ventricle during diastole is also increased in the healthy heart, but if the organ is weak and dilated, digitalis tends to diminish the relaxation. The auricular rate is slowed but in general its force is not so much affected as that of the ventricles. The **diastole** is **prolonged,** the **force of the systole increased,** and the size of the individual pulse-wave also increased. If the heart is beating at its normal rate the diastole is increased by digitalis, but if the beat is slow, and the slowness is due to weakness of the cardiac muscle, the diastole is diminished instead. The slowing of the pulse caused by the drug is apparently due to a simultaneous stimulation of both the central and peripheral vagus apparatus, since it has been demonstrated that the administration of atropine entirely does away with this slowing. Moreover, if section of the vagi is made, the slowing is much less than when these nerves are left intact, or it may be altogether absent. Under digitalis the **work** done by the heart is much **greater than normal,** and the slowness developed is not sufficient to counterbalance the increased output at each ventricular contraction.

In the second stage the pulse is very **slow** and **irregular,** for the reason that the inhibitory mechanism is powerfully stimulated. During diastole the ventricle dilates more completely than usual, while its systole varies in force. The contraction of the auricle becomes much weakened, and sometimes the rhythm of the latter is different from that of the ventricle. Under certain circumstances this stage may be absent.

The third stage is always developed if a sufficient quantity of the

drug be given. In this the heart's action becomes **extremely fast** and **irregular.** This accelerated rate is believed to be due, not to paralysis of the pneumogastric centers and cardiac peripheral filaments, but to such an increased irritability and excitability of the heart muscle that the inhibitory apparatus can no longer hold it in check. The rate of the contraction of the ventricle continues to increase, but the strength of its contractions diminishes. The output of blood from the heart continues much augmented during the first part of the third stage, and then rapidly declines. The auricle passes into the condition known as delirium cordis, and finally the ventricle also. Then the circulation is arrested; after which the heart dilates to an extreme degree.

Vessels.—Digitalis has the effect of markedly **increasing** the **blood-pressure** in the arteries. Three factors are concerned in producing this result, namely: The **expulsion** from the heart of **more blood than usual** and at a higher pressure, the **stimulation** of the **vaso-motor centers,** and the **direct action** of the drug **on the vessels** themselves, exciting a condition of abnormal activity in their muscular coats, and thus diminishing their calibre, to a great extent due to muscular action as is shown by the fact that, even for several hours it occurs in organs which have been excised; but, as this constriction is not so marked as when the drug is administered under normal conditions, the agency of the vaso-constrictor centers must also be recognized. While the blood-pressure rises in the arteries, the velocity of the current diminishes, and as the pressure rises in the arteries it declines in the veins; both these effects indicating an increased resistance.

Under toxic doses of digitalis the blood-pressure diminishes with the extreme slowing of the heart, but as the latter becomes accelerated it again rises to a pronounced degree; this result being due to the quickened heart and the contraction of the arterioles. Then, as the heart becomes irregular, the blood-pressure declines until finally the heart stops. This fall results from the decreasing efficiency of the cardiac contractions and from vaso-motor paralysis.

Recent experiments show that the increased blood-pressure is due to increased heart action and contraction of the vessels, and that the latter is due to peripheral action, which, for digitoxin, is general. With other glucosides (digitalin, strophanthin) the action is restricted to the splanchnic area. There is, however, some active con-

striction going on in the peripheral vessels, yet this is overcome by a passive dilatation, owing to reflux of blood from the intestines and an active reflex dilatation set up by the splanchnic contraction. The general narrowing of the pathway of the blood seen with digitoxin gives a high resistance which must be overcome by the heart; strophanthin, for instance, opens the vessels of the periphery, and this materially relieves the organ.

Kidney.—In dropsy, especially when due to cardiac disease, there is no question as to the value of digitalis as a **diuretic,** probably, to a large extent at least, indirectly rather than directly. Nearly all are agreed that the kidneys are affected principally through changes in the circulation, and the diuresis is probably due to the cardiac action of the drug. Under this hypothesis it is supposed that increased arterial, with diminished venous pressure leads to an increased flow of lymph into the blood-vessels. The blood is thus diluted, and the kidneys incited to special activity, while at the same time the nutrition of the organs is improved. In the main the diuretic effects are almost entirely due to the improvement in the circulation. In addition to this indirect action, there is some ground for believing that digitalis exerts a limited influence directly upon the renal epithelium, on which it probably acts as a mild irritant, but this effect is slight as compared with that produced by theobromine sodio-salicylate. By the diuretic action of digitalis the fluid of the urine is said to be much more largely increased than the solids.

Temperature.—In health, digitalis, in medicinal doses, has little or no effect on the temperature. In febrile conditions it has an uncertain antipyretic action. Toxic doses cause a sustained reduction of temperature, amounting to several degrees, but their first effect is to increase it. It is thought by some that this temporary elevation may be due to the local irritation of the drug, and that if this can be avoided the fall will occur without the antecedent rise.

Respiration.—It has little or no effect on respiration unless taken in toxic quantities, when, it is said, the respiratory movements become deep and rapid from central nervous stimulation, and this is synchronous with the fall of arterial pressure

Nervous System and Muscles.—In therapeutic doses the only effect of digitalis appears to be the stimulation of the inhibitory cardiac and the vaso-motor centers in the medulla oblongata. Toxic doses, however, stimulate other centers as the heat-regulating, lowering the

body temperature, the vomiting, and finally the convulsive, so that general convulsions may eventually result. They diminish reflex activity by directly exciting the reflex inhibitory centers of Setschenow in the medulla, and afterwards by depressing the spinal cord. Finally the motor nerve-trunks are depressed and the muscles are paralyzed. While the cerebrum is not directly affected by digitalis, the disturbances in its circulation caused by the drug are liable to give rise to severe headache, excessive vomiting, dizziness, vertigo, confusion of sight, and possibly hallucinations and delirium. In some instances the whole field of vision is said to be blue and in others yellow. Exophthalmos occurs, and a peculiar blue color of the sclerotic has been quite constantly noted in acute poisoning.

Uterus.—Digitalis appears to have some influence on the unstriated muscular fibers throughout the body, and it thus acts somewhat like ergot in causing contraction of the uterus.

Therapeutics of Digitalis

External.—Digitalis is sometimes used externally in the form of a poultice made from the leaves, and placed over the loins of patients suffering from renal congestion.

Internal.—The most important use of digitalis is in affections of the heart, indicated, in general, when the **cardiac action is rapid and feeble, with low arterial tension and venous engorgement** and contra-indicated when the cardiac action is strong and arterial tension high, and to a less extent when œdema is absent. It not only slows and steadies the heart, but also improves the nutrition of its walls by its stimulating influence on the pneumogastric nerve, as well as by increasing the blood supply of the heart muscle by rendering the systole more complete and prolonging the diastole. By its action the pressure in the coronary arteries is increased, and more time allowed for their filling. The benefit derived from the drug is not too inveterate cardiac disease is often in a measure permanent, by reason of the assistance which it affords in the production of compensatory hypertrophy. The relief of the circulation caused by it may in time bring about permanent nutritive changes in the heart-muscle, which is stimulated to such a marked degree by it, and dilatation is certainly less apt to occur when the muscular fiber is acting vigorously than when it is acting feebly. The constriction of the peripheral vessels caused by it has been thought by some to constitute a valid objection

to the use of digitalis, but this may not really be sufficient to seriously over-balance the increased cardiac power secured, while if such is the case, it may be readily counteracted by means of drugs having an opposing action, as the nitrites.

Mitral Regurgitation.—It is especially valuable in those instances of mitral disease in which **compensation** (the adaptation of the organs of circulation to the unusual conditions imposed upon them by the valvular lesion) **has begun to fail.** In mitral insufficiency the good effect caused by it is principally due to its tonic action in tending to produce a permanent systolic condition, in consequence of which the orifice of the valves is made smaller. In this way it abolishes the effects of the distention and tends to lessen the insufficiency. As regards the administration of digitalis, instances of mitral regurgitation have been divided into three groups, as follows: (1) Those in which the ventricle is but little enlarged, while the nutrition of its muscular wall is still well-preserved, and which may be attended with perhaps no inconvenience except more or less, usually slight, dyspnœa on exertion. (2) Those in which cardiac dropsy, of greater or less extent, is present. (3) Those in which, with extensive dilatation there is little or no cardiac dropsy, but well-marked symptoms of pulmonary congestion. In the last two varieties, digitalis is of the greatest service. By increasing the force of the contraction of the left ventricle it causes the approximation of the mitral flaps, thus reducing the amount of the regurgitation and diminishing venous congestion. The increased force of the systole will throw proportionately more blood through the aortic orifice than through the partially open and obstructed mitral valve, and more blood will pass into the general circulation, and thus the pulmonic vessels be relieved. The prolonged diastole will also be of service in allowing more time for the blood to flow into the left ventricle. Thus, both the auricles and ventricles gain increased power to empty themselves, and the longer intervals between the pulsations enable the former to more completely discharge their contents into the ventricles. The favorable action of the drug, therefore, is seen (1) in increasing the length of the diastole and thus improving the nutrition of the cardiac walls; (2) in increasing the tonic contraction of the heart, and thereby diminishing the size of the dilated cavity; (3) in increasing the force of the pulsations; and (4) in causing slower and much more regular cardiac rhythm. The general improvement in the circulation caused by it has an ex-

cellent effect in relieving the cardiac pain and distress and the dyspnœa and cyanosis incident to the disease, and the more an instance of mitral regurgitation is characterized by the œdematous type the more efficient will the drug prove and the converse of this statement is equally true. In addition, therefore, to its direct action on the heart, the beneficial effect of digitalis is shown in a marked increase in the quantity of urine, and hence it is of essential service in relieving cardiac dropsy. Here it not only regulates the circulation, by its action on the heart, and causes the evacuation of the surplus fluid through the kidneys, but also acts directly on the vessels by increasing vaso-motor force. In some instances the diuretic effect is assisted by the administration, in connection with it, of an alkaline diuretic, such as potassium bitartrate or citrate, and occasionally it may be found that diuresis can be established only after free purgation. Owing to the disordered circulation, sleeplessness is often a marked symptom of serious cardiac disease. The normal relationship between the cerebral vessels and the general circulation is not maintained, and by restoring this, digitalis gives the patient ability to sleep. The dyspnœa is relieved by the action of the drug in improving the venous flow toward the heart, thus counteracting the venous engorgement and œdema of the lungs, the liver, the kidneys, and the subcutaneous tissues, and failure of the right side of the heart, so commonly met with.

There are some instances of mitral regurgitation, in which it proves injurious, due, in a portion of them at least, to its causing too great a strain upon the auricle. The ventricle, as has been stated, is more affected by the drug than the auricle, and as with a very patulous mitral valve the blood is readily backed upon the auricle, so the latter, already weak, cannot withstand the strain imposed upon it by the ventricle thus stimulated.

Mitral Stenosis.—In most instances of mitral stenosis benefit will attend its administration. The increased resistance here leads to the same general results as the leakage in mitral insufficiency, and, like the latter, it can be successfully combated by the effect of the drug in strengthening the heart-beat. The lengthening of the diastole caused by it will allow more time for the auricle, the contracting power of which is at the same time increased, to empty itself into the ventricle through the constricted orifice. The ventricle, thus more perfectly filled, sends out more blood into the systemic circulation. In addition, the circulation is further improved by the stimulating effect of

the digitalis on the right ventricle, which enables it to overcome the tendency to congestion arising from the obstruction on the left side of the heart. It is possible, however, that the increased work of the right ventricle, combined with the stenosis of the mitral valve, may tend to produce congestion of the pulmonary vessels, with the result of lessening the oxygenation of the blood and so interfering with the nutrition of the heart. On the other hand, the slowing of the organ will afford the blood-vessels of the lungs more time in which to empty into the heart; so that in well-selected instances the beneficial effects of digitalis will greatly over-balance any possible evil ones. The general amelioration of symptoms caused by it is much the same as in patients suffering from mitral regurgitation.

Diseases of the Tricuspid Valve.—In both tricuspid constriction and insufficiency digitalis is of service, but less beneficial, in the same manner as in mitral disease, and it has been found particularly useful in instances of regurgitation with dilated right ventricle, but the rational signs furnish, for the most part, clearer indications than the physical, for the use of digitalis. Thus, it is indicated when the cardiac action is rapid and feeble and the tension of the pulse low, and when there are cough, dyspnœa, pulsating jugulars, duskiness of the countenance, scanty, high-colored urine, and general dropsy.

Diseases of the Aortic Valve.—There is a considerable diversity of opinion as to the advisability of giving digitalis in aortic disease. While, however, a few assert that its disadvantages are more than offset by its advantages, there can be but little question that in **uncomplicated aortic regurgitation the drug is injurious,** rather than beneficial. It increases the work of the heart, and the prolonged diastole caused by it favors the return of blood through the imperfectly closed orifice and exposes the ventricular wall to excessive strain; so that there is danger of syncope. In aortic stenosis, before compensatory hypertrophy has occurred, it may sometimes be of service. There is more or less obstruction to the normal flow of blood out of the heart, and digitalis will **increase the ventricular force,** so that it may overcome the difficulty. After the impediment to the circulation caused by the valvular defect has been compensated by a sufficient amount of cardiac hypertrophy it is not only useless, but may give rise to serious and even fatal results. But when aortic constriction leads to mitral incompetence and regurgitation, it may be given with advantage.

So also in aortic regurgitation, when the marked cardiac dilatation, likely to be caused by the condition, has given rise to mitral insufficiency, digitalis is of great value. Other instances are those in which there is considerable dilatation of the left ventricle, perhaps of sudden onset, and in which the prominent symptoms will be found to be shortness of breath, præcordial pain, and anxiety. While digitalis is generally contra-indicated in aortic regurgitation, especially when the latter, as often occurs, accompanies aortic constriction, yet when the heart-muscle fails and the hypertrophy is not compensatory, it is useful in both conditions. In all instances of aortic valvular disease, however, the effects of the drug should be very carefully watched.

It has been well said that the indication for giving or withholding digitalis in the treatment of valvular disease of the heart rests not so much upon the particular valvular lesion that is present as on the effects which have been produced by this upon the cardiac wall. A knowledge of the relation of the ability of the heart-muscle to do the work required of it in any individual is much more important, therefore, from a therapeutic point of view, than a recognition of the pathological condition of one or more of the valves. In general terms it may be stated that digitalis is of special value in all conditions in which dilatation of the heart cavities has been brought about by failure of the muscular wall as a result of valvular disease.

Constriction of the peripheral vessels which, as has been seen, is one of the chief physiological effects of digitalis, is sometimes so marked as to interfere materially with the successful use of the remedy in cardiac affections; this may be counteracted to a considerable extent by the simultaneous administration of drugs causing vasodilatation, such as the nitrites. Nitroglycerin is a very useful agent for relaxing the spasm, and as its effect lasts but a short time while that of the digitalis is prolonged, it should be given alone and at much more frequent intervals than the latter. As digitalis acts very slowly and maintains its effect for a long time, it may be sufficient, after its primary effects have been obtained, to administer it only once a day, for the purpose of continuing its influence.

Cardiac Disease Other Than Valvular.—In palpitation due to overexertion or heart-strain, and in cardiac dilatation and asthenia, digitalis is of decided value. In the "irritable heart of soldiers,"

a condition associated with muscular weakness and supposed to be dependent upon exhaustion of the inhibitory nerves, it has been found better than any other remedy. When however, cardiac hypertrophy has occurred it is of but little service, also for those individuals who have engaged to excess in athletic exercise and who are troubled with shortness of breath, but without any appreciable valvular lesion of the heart, but in whom the apex is found to be outside its normal position. Digitalis is frequently prescribed in tachycardia (rapid heart), but if acceleration of the rhythm is the only symptom observed, other drugs, such as aconite, may generally be substituted for it with advantage. In functional derangements of the heart, usually the result of faulty digestion, characterized by irregularity and palpitation, digitalis is indicated and will prove of essential service if it can be given in such a way as not to disagree with the stomach. In certain highly neurotic subjects it is of marked benefit, but in a large number of these it fails to give relief. It is of great value in the weakness of the heart resulting from infectious diseases, even if no valvular lesion is present. The beneficial action of the drug is seen in the increased efficiency of the contractions and in the prolonged diastole, which allows more time for the cardiac muscle to rest. Here its effect may often be increased by combining it with caffeine or ammonia. If the latter is used, 8 mils (2 fl. dr.) of the infusion of digitalis may be given, with 0.20 mil (3 ♏) of stronger ammonia water, in a little water. It is often desirable to administer digitalis in combination with iron; but when its fluid preparations are associated with salts of the latter the mixture is rendered inky by the action of the iron on the tannic acid in the digitalis. This difficulty may be obviated by adding a little diluted phosphoric acid, or a pill may be used composed of powdered digitalis leaves and dried ferrous sulphate. Digitalis is also useful as a stimulant in cardiac weakness resulting from such causes as hæmorrhage, injury, poisoning and shock. In conditions of this kind, on account of the slowness of its action, it should be preceded by ammonia and alcohol if the symptoms are urgent; or its slowness of action may be overcome by administering the tincture hypodermatically. Digitalis is particularly indicated in poisoning by aconite and the nitrites, to which, as regards action on the heart, it is the physiological antidote. In organic non-valvular diseases of the heart dependent on degeneration of the cardiac muscle its effects are generally decidedly injurious.

In fatty and other degeneration, such as those resulting from alcohol and from chronic nephritis, the muscle cannot respond to the stimulation of the drug, while the peripheral resistance is increased from the vascular constriction caused by its action. Under these circumstances it is possible that some of the degenerated fibers may rupture. In dilatation of the right side of the heart associated with chronic disease of the lungs digitalis may sometimes, but exceptionally, prove of service. In the palpitation which is often such a distressing feature of phthisis it has been found useful.

The indications for the use of digitalis in cardiac disease are either the failure or impending failure of compensation and the existence of this condition is fundamental if benefit from the use of the remedy is to be expected. The largest number of instances of cardiac failure are marked by **auricular fibrillation** and fortunately the effects of digitalis are not only constant but startling in the benefit which it causes. It accomplishes this result by diminishing the conductivity of the auriculo-ventricular bundle. The doses must be large and since the infusion represents the entire drug, this is the preparation to be employed. If the condition has been long established, so soon as it is controlled, smaller doses of the infusion must be given at regular intervals, for months or even years.

Bright's Disease.—In renal dropsy from acute desquamative nephritis (tubal nephritis) digitalis, given in the form of infusion, has been found of considerable value. While several days may elapse before much effect is produced, the flow of urine is sometimes enormous, and this fact is regarded as showing that digitalis has a direct action on the glomeruli of the kidney. Although it is not infrequently given in acute Bright's disease, however, it has been questioned whether, if it has the effect of causing dilatation of the renal arteries, it is proper to increase the circulation in any acutely inflamed organ or increase the already raised arterial tension. In chronic Bright's disease the arterial tension is still further increased, and as, furthermore, digitalis is an uncertain diuretic where the heart is not affected, the drug is contra-indicated, especially in uncomplicated instances of chronic tubal nephritis. Still another reason is that it retards the elimination of urea and the chlorides. In many instances of granular, contracted, or cirrhotic kidney, however, where the cardiac hypertrophy induced has not succeeded in overcoming the peripheral resistance, and in consequence there has occurred dilata-

tion of the left ventricle and of the mitral orifice, with resulting regurgitation, digitalis, acting in the same manner as in instances of mitral regurgitation without renal disease, renders efficient service, especially given as the diuretic pill, known as Guy's, consisting of blue mass, digitalis, and squill, .06 gm. (1 gr.) each, made up with extract of hyoscyamus .03 gm. (½ gr.).

Exophthalmic Goiter.—It has been used to a considerable extent in this affection, but has proved an uncertain remedy, but sometimes is remarkably successful in controlling the symptoms. It may be combined advantageously with iron, ergot and zinc bromide. Even in incurable patients the cardiac irregularities and the dilatation of the cervical vessels are sometimes ameliorated, while instances that are purely functional in character, in young subjects, have been reported to be cured by digitalis.

Bronchitis and Pneumonia.—In chronic bronchitis with profuse secretion it has been found of some service in diminishing the secretion and pulmonary congestion, and consequently the dyspnœa, sweating and progressive loss of strength caused by them. It is also sometimes serviceable in chronic bronchitis with interstitial pneumonia (fibroid phthisis), when accompanied with dyspnœa, secondary dilatation of the right heart, and general anasarca. Here it may lessen the cough and expectoration, tone up the weakened and laboring heart, and reduce the œdema. In the second stage of acute pneumonia, when the heart, with almost empty arteries, is laboring and unable to do its work properly, it has proved to be of very great value. In any form of pneumonia, whether adynamic or not, when the right heart is becoming unable to force the blood through pulmonary capillaries which are compressed by the existing exudation, digitalis may be found extremely useful, especially in the bronchitis and broncho-pneumonia of children.

Scarlet Fever.—Some highly recommend digitalis in this disease, in which it is claimed that it reduces the temperature and maintains the action of the kidneys; thus diminishing the two principal sources of danger. From a teaspoonful (4 mils) to a tablespoonful (16 mils), of the infusion according to the patient's age, may be given every four hours.

In various adynamic fevers digitalis is sometimes of the greatest value, in sustaining the heart's action during a crisis or period of special strain upon the organ.

Alcoholism.—In chronic alcoholism digitalis, in moderate doses, may prove of service, on account of the stimulating effect of the agent on the circulation. As to its value in delirium tremens, some maintain that it is practically useless, others that excellent results may be obtained from it, especially in instances where the pulse is very weak and compressible. The rest and sleep which follow its administration are believed to be due to the cardiac stimulation and increased flow of blood to the nerve-centers, caused by it. While enormous doses of the drug—15 mils (½ fl. oz.) of the tincture being a dose which is not unusual—are generally tolerated by these patients, probably because by long habit the heart has become accustomed to the influence of stimulants, their use is by no means unattended with danger. Some who believe in the efficacy of digitalis in this condition regard these large doses as unnecessary, and also hold that the infusion, 15 mils (one tablespoonful), every four hours, is preferable to the tincture. Digitalis is sometimes given to the young and robust, with marked cerebral hyperæmia, but it is probably more efficacious in pale subjects with a tendency to cyanosis, in whom there is cerebral anæmia, with effusion and œdema. Although there is generally a remarkable tolerance for digitalis in this condition, since the use of the drug is occasionally followed by fatal results, it would seem to be prudent to carefully select the patients for whom it is to be employed and to avoid excessive doses.

Spermatorrhœa.—Digitalis is capable of temporarily but completely annulling the activity of the sexual organs, and it is therefore of service in preventing erections due to local irritation, and also nocturnal seminal emissions, and other results of genital excitement. It is adapted for the treatment of atonic spermatorrhœa, shown by feeble erections, frequent emissions, and cold hands and feet, where it may advantageously be combined with ergot. In the spermatorrhœa of plethora, it is claimed that better results can be obtained from digitalis in combination with potassium bromide than from any other treatment.

Hæmorrhage.—Digitalis is occasionally prescribed as a hæmostatic, but it is generally contra-indicated because the increased blood-pressure to which it gives rise may excite still greater hæmorrhage. It may sometimes prove useful, however, in hæmorrhage from a large surface, as in the hæmorrhagic diathesis and in pulmonary

hæmorrhage. It has been found of advantage in hæmoptysis due to disease of the mitral valve.

Uterus.—If, as seems to be the fact, digitalis has the power of inducing uterine contractions, it would naturally be expected that it would be, and it is, of service in menorrhagia or metrorrhagia when occurring in plethoric individuals and where the hæmorrhage is dependent upon mitral disease which is sometimes of a peculiarly obstinate kind. Digitalis has also been used successfully to arrest *post-partum* hæmorrhage, but is much inferior to ergot in this respect.

Cumulative Effect and Contra-indications.—Digitalis should always be administered with caution, and it is advisable to commence with small doses, excepting in auricular fibrillation, gradually increased, if necessary. A patient taking full doses of the drug should be kept in the recumbent posture. When, under its influence, the pulse has become much reduced, on rising the heart is sometimes suddenly found unequal to maintaining the circulation in face of the increased resistance in the arterioles, and against the force of gravity; so that fatal syncope may occur. Digitalis should always be stopped as soon as nausea, which is probably of central origin, or symptoms of gastro-intestinal irritation supervene, or the pulse becomes abnormally slow. If the tincture is employed, that which is fat-free will be found less likely to disagree. In this the fixed oil of the leaf and its free acids are eliminated. Some individuals are unable to take digitalis at all, on account of the nausea which it produces. It must not be forgotten that digitalis has a cumulative effect, and this is probably due to vaso-spasm and to the fact that the drug is not excreted by the kidneys as fast as it is absorbed, and consequently accumulates in the system. It sometimes happens, therefore, that, without any increase in the dose, individuals who have taken digitalis for a long period suddenly develop symptoms of poisoning which may be avoided if the doses are given at proper intervals; the effects of each being allowed to subside before the next is administered. The plan has been adopted of stopping the remedy for two days at the end of each week. Others continue it for ten days, then intermit for four days and begin again. It should be continued no longer than is necessary to re-establish compensation. Digitalis is contra-indicated wherever, with dilatation there is extensive degeneration of the muscular wall, as the muscle is likely to be too weak to respond to its stimulus. Under these circumstances, the

digitalis by increasing the pressure against which the heart has to contract, may produce the most serious results. Thus the systole becomes even weaker than before its administration and cerebral anæmia, syncope, and perhaps sudden death may ensue.

Antagonism.—Reference has been made to the antagonism between digitalis and other drugs. Aconite, while it also slows the heart, does so by dilating the peripheral vessels and lowering the blood-pressure, and is a cardiac poison; directly depressing the action of the cardiac motor ganglia and thus weakening instead of strengthening the pulsation. Aconite acts quickly and digitalis very slowly, and this interferes to some extent with the efficacy of the latter in poisoning by the former. Opium, aconite, lobelia, the nitrites, and other agents antagonize some of the actions of digitalis, but the antagonism does not extend throughout the whole range of their effects. Saponin, found in many plants, and senegin, the glucoside to which it is closely allied, are considered to be most complete physiological antagonists to digitalis. Tannic acid is the chemical antidote.

STROPHANTHUS

For the Preparations of Strophanthus *see* p. 136.

Action of Strophanthus

External.—It has no action on the skin, but causes marked irritation of mucous membranes. Locally its glucoside, strophanthin, is an anæsthetic, rapid in action and durable in effect, but so irritating that its application is liable to set up inflammation and even ulceration.

Internal.—*Gastro-intestinal Tract.*—In small doses it promotes appetite and digestion, and in larger ones it does not ordinarily cause gastro-intestinal derangement. It is true that, vomiting and diarrhœa are sometimes occasioned, but it will generally be found that these disturbances result from preparations from which the fixed oil contained in the seeds has not been extracted. It is slowly absorbed from the alimentary tract, but more rapidly than is digitalis. Strophanthin, used hypodermatically, is not irritating to the digestive tract and produces its effects promptly.

Muscles.—Strophanthus is essentially a **muscle poison,** as shown in experiments with the African kombé arrow poison, which is made from the plant. Its first effect is to increase the tonicity of the muscular fiber, and when the muscle dies it passes directly into post-mortem rigidity. It occasions stiffness of the limbs and afterward complete loss of voluntary movement. Its influence is more general-

ized than that of digitalis, which, while acting on all the muscular tissue, has a more special action on the heart and the muscle of the arterial wall. The physiological as well as the toxic actions of strophanthus are mainly exerted on both the heart and the voluntary muscles, so that when full effects are produced on the cardiac muscle, the general muscular system is decidedly affected. In toxic doses it paralyzes muscular tissue, not through the nervous system, but by **direct contact,** and when contractility has once been destroyed by its action, no stimulus will re-excite it.

Heart.—Strophanthus being believed to exert its action upon muscular tissue by direct contact through the blood, and the heart naturally receiving a much larger supply of blood in the same length of time than any other muscle, that organ is promptly and decidedly influenced by the drug. By proper regulation of the amount administered the heart may be acted upon while the muscles in general remain practically unaffected. In moderate doses strophanthus has the **same, but a more marked effect** on the heart **as digitalis,** stimulating the tonic contraction of the cardiac muscle, increasing the force of the ventricular systole, prolonging the diastole, slowing and regulating the rhythm, and causing a pronounced though slow rise in the arterial pressure by the increased force in the cardiac contractions. While some authorities deny that it acts on the pneumogastric like digitalis, and others assert that it has a similar influence on the inhibitory mechanism, there can be no question that it does have the effect of slowing the rate of the beat, apparently as the result of its direct cardiac action. If it has any influence at all upon the innervation of the heart, this would seem to be but temporary. In large amounts the drug paralyzes the heart, leaving its muscle completely relaxed.

Vessels.—The latest researches show that strophanthus, through its characteristic action on all muscular tissue, including that in the arterial walls, has a decided influence upon the vaso-motor system; but the **constriction** of the peripheral vessels due to it is considerably **less marked** than that caused by digitalis. This is the most important point of difference between the two agents, and for this reason the former is the safer remedy of the two.

Kidneys.—Strophanthus is an **efficient diuretic,** increasing the quantity of urine not only in instances of cardiac disease, and this influence is apparently exerted not only through the increased force

of the heart and the effect on the circulation caused by it, but also through direct action upon the secreting structure of the kidneys. The correctness of this view seems to have been confirmed by the renal lesions observed in poisoning by strophanthus and by oncometric experiments indicating that it produces no marked congestion of the kidneys.

Nervous System.—As has been stated, the pronounced effects which it has upon the heart and muscles are in all probability due solely to its direct action by contact, through the blood, and not through the agency of any influence it exerts upon the nervous system.

Respiration.—Strophanthus appears to have no action on the respiratory centers. In experiments it was found that the respiration continued for some length of time after the heart stopped, due to muscular influence.

Temperature.—It is antipyretic within a limited range, because under its administration the consumption of oxygen is smaller and the processes of combustion are depressed.

Absorption and Elimination.—Since strophanthin is soluble in less than its own weight of water, it gives prompt results. The active principle of Strophanthus escapes with the urine, so that we also have ready elimination, although somewhat slower than its absorption, and there is, therefore, an overlapping of effect from too frequently repeated doses. Habit does not seem to impair the therapeutic usefulness of the drug.

Therapeutics of Strophanthus

Having the same general effects, strophanthus is employed to fulfil the same indications as digitalis. On the heart it acts more promptly, though probably less permanently than the latter. As the indication is generally as much to diminish the resistance to the heart as to increase the amount of work which the organ is capable of doing, strophanthus has the great advantage over digitalis of not greatly constricting the arterioles. If, therefore, the heart is feeble and the arterial tension high, strophanthus is decidedly to be preferred. In those instances where digitalis does harm by so overstimulating the ventricle that the auricle cannot thoroughly empty itself, and hence becomes over-filled, strophanthus is sometimes of the greatest service. Where extensive degeneration of the arterial

walls is present, so that the increased pressure in the interior of the vessels may lead to rupture of their walls, strophanthus, by causing a less extensive rise in the blood-pressure than digitalis, should be employed if the administration of a cardiac stimulant is called for. Its superiority as a **diuretic** renders it particularly valuable in œdema of the lungs or instances of general cardiac dropsy. It is given advantageously where the administration of digitalis has to be suspended either on account of gastric irritation or for the prevention of cumulative effects. It is of great value in the cardiac diseases of **children**, whose vaso-motor system is more impressionable, in which the latter is apt to fail, and excellent results may also be obtained with it in corpulent individuals. Of especial importance should be considered its administration for the weak hearts of anæmia and chlorosis, in order that nutrition may be improved; for so-called irritable hearts, where the pain and palpitation are relieved; for debilitated hearts, associated with dyspeptic symptoms, and for particularly flatulence, which usually disappears; and in the **aged** when there is vertigo as the results of cerebral anæmia. It is also said to be particularly useful in the progressive heart-failure of elderly patients, with attacks of dyspnœa simulating angina. The advantages which strophanthus possesses over digitalis may be summed up as (1) greater rapidity, modifying the pulse-rate within an hour or two; (2) less marked vaso-constrictor effects; (3) greater diuretic powers; (4) no disturbance of digestion from properly made preparations; (5) absence of so-called cumulation; (6) greater value in children; and (7) greater safety in the aged.

The therapeutic indications for the use of strophantus are, then: (1) Rapidly recurring cardiac systoles of lessened force and irregular rhythm. We obtain, first, a more vigorous contraction of the ventricle, with a slowing of the pulse-rate and consequently a lengthening of the diastole, which is the period of rest for the heart; next comes the disappearance of irregularity of rhythm, although for this particular symptom digitalis is preferable (*see* p. 439), and, lastly, from improved nutrition, a permanent strengthening of the heart-muscle. (2) The comparative insignificance of its vaso-motor effects enables the use of this remedy in those instances of permanent high tension which are met with in some forms of Bright's disease, in arteriosclerosis, and in the rigid arteries of the aged. (3) Whenever diuresis can be promoted by increased blood-tension resulting from more vigor-

ous cardiac contractions this may be expected from the use of this remedy. (4) The rapidly appearing effects of its administration, together with its regular elimination, make it the drug of choice when the symptoms are urgent. (5) The absence of digestive disturbances from therapeutic doses and slight likelihood of habituation to its administration make it important when long-continued use is necessary. It should, therefore, be the remedy of choice for all patients, (1) in whom we wish to establish compensation; (2) for arterial degeneration in which a remedy which causes more energetic cardiac contraction is required; (3) for cardiac disease when a diuretic is necessary; (4) for weak or irritable hearts; and (5) for the the treatment of cardiac disease in childhood or old age.

The instances in which failure will follow its administration are those of (1) advanced degeneration of the myocardium; (2) extreme mechan'cal obstruction to the circulation from valvular incompetency or obstruction; and (3) a combination of these. It will readily be understood that in fully compensated hearts this—as well as other drugs of he same type—is unnecessary, and when over-compensation exists it will likely aggravate the cond'tion.

SQUILL

For the Preparations of Squill *see* p. 137.

Action of Squill

The application of squill to the integument is capable of producing the characteristic effects of the drug on the system. It affects the heart and arterial system in the **same manner as digitalis,** but its action on the heart, and especially on the peripheral vessels, is less marked. The increased arterial pressure caused by it is due, it is believed, partly to the augmented cardiac force and partly to a peripherally produced vaso-motor contraction. It is a much more violent **gastro-intestinal irritant** than digitalis; causing, in sufficient doses, marked abdominal pain, vomiting, purging, and even fatal gastro-enteritis. Even small doses are liable to cause nausea. Another pronounced action of squill is that of an **expectorant,** and this is probably produced during its excretion. In addition, it is an efficient **diuretic,** promoting the activity of the renal circulation, and largely increasing the watery portion of the urine. In excessive

doses it gives rise to such irritation as to cause strangury and diminished secretion, the urine often being bloody and albuminous. The renal inflammation may even be so violent as to result in complete suppression.

Therapeutics of Squill

Squill has been called the "harsh digitalis." In cardiac disease, with or without dropsy, it is not prescribed alone, as other heart stimulants are more efficient, as well as less toxic, in their effects. It may, however, be combined with digitalis and mercury with advantage, especially in dropsical patients, and a favorite diuretic is Guy's pill (*see* p. 440). Squill was formerly much in vogue in the treatment of renal dropsy, but is now used only in dropsy not dependent on renal disease when the system is in an atonic condition, and it has been found of service, especially in combination with calomel, in serous effusion into the pleura and the pericardium resulting from chronic inflammation. Squill is principally used, however, in subacute and chronic bronchitis and emphysema. It is particularly indicated when the sputa are tenacious and coughed up with difficulty, and it is therefore desirable to employ with it an agent which increases the expiratory force. As a stimulating expectorant, it is especially useful in the second stage of bronchitis, when secretion is scanty or so excessive as to need proper stimulation of the mucous membrane to bring on a healthy action. It should not be given to patients suffering from phthisis or other chronic disease where there is any gastric irritation. Neither the syrup nor the vinegar of squill should be prescribed with ammonium carbonate, as the latter is incompatible with acetic acid, which is contained in both of these preparations.

OXYGEN

For the Preparation of Oxygen *see* p. 38.

Action of Oxygen

The first sensation of oxygen, inhaled as such, is one of warmth in the respiratory passages. The appetite is increased, and a feeling of mental exhilaration and a disposition to greater bodily activity are produced. The pulse is generally quickened and the blood-tension rises; it acts upon the blood by increasing the number of the red corpuscles. As it forms a definite compound with the hæmoglobin of the

blood and as soon as this is saturated no more can be taken up so the capacity of the blood for the absorption of oxygen is limited. In disease, however, if the absorption of oxygen is in any way impeded and the blood passes through the pulmonary circuit before it can absorb all the oxygen which it is capable of, the indication is for an artificial supply of oxygen for a more complete oxygenation.

Therapeutics of Oxygen

Oxygen inhalations are used in cardiac diseases, pneumonia in its various forms, pulmonary œdema, emphysema, convulsions, chloroform and nitrous monoxide narcosis, asphyxia from toxic gases and from substances such as strychnine, and in various other conditions characterized by great lividity of the skin or by dyspnœa due to causes interfering with the **oxygenation of the blood,** including those of cardiac origin. Even though they should fail to exert a fatal issue, they often relieve the distress of the patient, and in many instances they are of material assistance in tiding over a temporary danger of death. In various chronic conditions, as anæmia, albuminuria, glycosuria and the different forms of **suboxidation,** the persistent use of oxygen has given good results. It is beneficial in some instances of pulmonary tuberculosis, especially when there is much emaciation and disturbances of digestion but in which the changes in the lungs have not resulted in a febrile reaction. If cavities have formed and the respiratory area is markedly diminished inhalations of oxygen will relieve the dyspnœa. It is said to be preventive of mountain sickness. In the use of this remedy small quantities of the gas and frequently repeated give the best results. The stream of flow should be gentle and the inhaler should not be held too near the patient; the best practical results are obtained when the oxygen is well mixed with air before it is inhaled.

CAMPHOR

For the Preparations of Camphor *see* p. 139.

Action of Camphor

External.—Like the volatile oils, camphor acts as an irritant. It is a direct cutaneous stimulant, causing **redness,** itching and **warmth,** owing to a local dilatation of the vessels. Later this is followed by

some **local anæsthesia** from paralysis of the sensory nerves. On mucous membrane it produces similar irritation, as indicated by congestion and smarting. It has some antiseptic action, but this is considerably weaker than of many of the volatile oils.

Internal.—*Gastro-intestinal Tract.*—In small doses it is **stomachic** and **carminative,** inducing a feeling of warmth and comfort in the stomach. It causes dilatation of the vessels, and thus has a mildly **stimulating** effect on the secretion of gastric juice and on peristalsis. In larger amounts it may produce sufficient irritation as to cause nausea and vomiting. In medicinal doses it has little action on the intestines themselves, but it exerts quite an efficient antiseptic influence in the bowel, as the amount of combined sulphates in the urine have been shown to be diminished by it.

Absorption and Excretion.—Camphor is absorbed with considerable rapidity from the stomach and intestine, as well as from the skin and the respiratory mucous membrane when in contact with them, and is excreted in part in the urine as camphor-glycuronic acid. When used hypodermatically it is irritant but nevertheless is quickly absorbed. In animals poisoned with camphor a considerable quantity of glucose is said to be frequently present in the urine.

Blood.—It is said to increase the number of leucocytes in the blood.

Heart and Circulation.—While there is a primary acceleration of the pulse-rate due to the local irritant effect on the alimentary mucous membrane, the heart is generally **slowed** by the drug, while the **contractions** are at the same time greatly **strengthened,** due rather to a direct stimulation of the cardiac muscle than to the influence of the regulating nerves. There may, however, be some slight reflex stimulation of the organ. In the normal heart camphor usually produces lengthening of the systole and shortening of the diastole and the pulse becomes fuller, stronger and slower. The blood-pressure may either rise or alternately rise and fall, which variations persist after convulsive movements have been prevented by curare, and it is therefore believed that the rise is mainly caused by a **stimulation of the vaso-motor center,** and that this stimulation is intermittent in character, since the variations mentioned are independent of the respiration. The stimulation of the heart and the reflexes, especially those arising from the stomach, also, on doubt, contribute to the rise in blood-pressure.

Respiration.—The respiration is usually but slightly affected, but a rule becomes slower and deeper under large doses. Whether ıy excretion of the drug takes place by the lungs is not positively ıown, but the breath of persons using it sometimes smells of it, and is thought probable that some camphor or some derivative from , is excreted by the bronchial mucous membrane, the vascularity ıd secretion of which is thus stimulated. It is generally regarded ı an expectorant of somewhat feeble power.

Nervous System.—The action of camphor on the central nervous ystem in mammals has been found to consist in **stimulation,** followed y paralysis of the cerebral areas and probably of other intracranial :nters, with less marked effect on the spinal cord. As regards the rain the stimulant symptoms begin in man with excitement, im-ulsive movements, confusion and delirium with hallucinations, and these are followed by **epileptiform convulsions,** pointing to an affection of the cerebral cortex. The first evidence of stimulation of the medulla is vertigo. Later, all the medullary centers are stimulated: the respiration is increased in volume, the blood-pressure rises, and the face and skin become flushed in consequence of the stimulation of the vasodilator center. Under sufficiently large doses the medulla is paralyzed, and collapse ensues, with death from failure of the respiration. Sometimes, however, the respiration ceases during a convulsion, and fails to return when it passes off. In man the epileptiform convulsions alternate with intervals of quiet and unconsciousness, until the patient sinks into complete stupor; and in exceptional instances there is no stage of excitement, the patient at once falling into a condition of drowsiness, unconsciousness and stupor. The susceptibility to the effects of camphor varies very greatly in different individuals. A considerable amount of exhilaration will be produced in some persons by .60 gm. (10 gr.) while in others the only effect observed will be a sense of comfort and restfulness.

Temperature.—In health the temperature is not affected, but in fever, camphor has, like many aromatic bodies, some antipyretic action.

Muscles.—In experiments, made with an ergograph, the drug sometimes seemed greatly to increase the energy and endurance of human muscles, but in other instances failed to have any influence.

Skin.—It has a mild **diaphoretic** action, and this may be due in part to its effects on the central nervous system.

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Skin.—It has a mild **diaphoretic** action, and this may be due in part to its effects on the central nervous system.

Sexual Organs.—Occasionally camphor has the effect of inducing dysuria. In small doses it sometimes appears to increase the sexual appetite; but any such effect is probably to be attributed merely to its general stimulant action on the circulation. In large doses it has been held by many to be anaphrodisiac.

Therapeutics of Camphor

External.—On account of its stimulating properties, camphor is probably employed more extensively as an ingredient of liniments of various kinds than any other drug. Thus, as a mild irritant it is rubbed into the skin for the relief of internal inflammations, chronic exudations and inflammatory indurations. In such conditions as myalgia, sciatica, lumbago and neuralgia of superficial nerves it also serves the same purpose, and in addition, by its effect in inducing local anæsthesia, tends to allay the pain. Camphor and hydrated chloral, triturated together, form a solution which will take up morphine and other alkaloids in considerable quantity, and such a solution can be mixed with chloroform without precipitation. This mixture constitutes a topical application of great value in the treatment of pain and inflammation; and it may be either painted on the affected part with a camel's-hair brush or applied on absorbent cotton or lint which is then covered with oiled silk. The liquid preparations of camphor and hydrated chloral, with thymol or phenol are excellent local applications for neuralgia, and may also be applied on cotton to the cavities of aching teeth. The solution of camphor in ether has been applied locally with benefit in erysipelas, and powdered camphor, freely sprinkled over the surface, is sometimes successful in preventing pitting of the face from small-pox. In chilblains, ointments or liniments containing camphor are often useful. For roughness of the skin camphor may be employed, incorporated with hydrous wool fat. Either alone or in combination with other agents it is of service in relieving the itching of eczema and other cutaneous affections. Fluids having valuable **antiseptic** powers are formed from camphor with phenyl salicylate or betanaphthol, and mixtures of camphor with menthol, of various strengths, are employed in acute nasal catarrh, pharyngitis and laryngitis, and in hypertrophic rhinitis. The vapor of camphor is inhaled with some relief in coryza and also in some forms of headache. In the house-

hold the spirit or "eau sédative," applied on a bandage, is a popular remedy for headaches and various neuralgic pains. Camphor enters into the composition of many dentifrices.

Internal.—Camphor is contra-indicated in inflammatory diseases of the gastro-intestinal mucous membranes. It is much used as a **carminative,** particularly in neurotic individuals. A few drops of the spirit will often give relief in hysterical vomiting, and camphor water with compound tincture of lavender is an excellent remedy for hysterical flatulence. Camphor in combination with opium, to which rhubarb, capsicum, chloroform or some astringent is often added, is very largely used in the treatment of diarrhœa, and even in the preliminary diarrhœa of Asiatic cholera has frequently proved of the greatest service. It is very commonly used for aborting colds and in the treatment of acute rhinitis. For the treatment of acute coryza an excellent combination consists of camphor, quinine sulphate, or better tannate, and fluidextract of belladonna, or preferably atropine sulphate, administered in pill or tablet. As camphor tends to allay cough and promote expectoration, it is a common ingredient of cough mixtures, in the form of paregoric, especially in chronic bronchitis, emphysema, and capillary bronchitis. Administered with spirit of chloroform and compound tincture of lavender, spirit of camphor has been given with advantage in influenza. In typhus and typhoid fever and in the exanthemata generally it has long been used as a **cardiac stimulant,** and also for the purpose of quieting delirium, subsultus or restlessness. In senile and hospital gangrene large doses of camphor have proved of value, while the powdered drug has been applied with advantage to the sloughing surfaces. According to some, 2 gm. (30 gr.) a day may be given hypodermatically, in the form of a 10 per cent. solution of olive oil, in the profound adynamia of acute endocarditis, or of typhoid fever with great benefit. Recently excellent results in infectious pneumonia have been claimed for the hypodermatic injection of 10 mils (2½ fl. dr.) of a 30 per cent. solution camphor in olive or cottonseed oil, and repeated every eight to twelve hours. The official camphor liniment (camphorated oil) must not be used for this purpose. A clyster of camphor is also an effective remedy against thread-worms. A full dose of camphor is sometimes given to arrest the strangury produced by cantharides when used for blistering, and it is a common remedy in attacks of nervousness and for delirium tremens. It is useful

in nervous dysmenorrhœa and, combined with morphine, is commonly relied upon for the relief of after-pains. There are, indeed, many conditions met with in women to the alleviation of which no one remedy seems so well adapted as camphor. Monobromated camphor is used as a nervous sedative. Its action is not identical with that of the bromides, however, as the bromine is present in a different form, and it is stated that no bromine-ion is liberated; so that the bromine effect would seem to be limited. It can often advantageously replace camphor in the treatment of acute rhinitis.

MUSK

For the Preparations of Musk *see* p. 244.

Action and Therapeutics of Musk

Musk is regarded as **stimulant** and **antispasmodic,** supposedly acting in the same way as camphor. According to some, musk causes headache, giddiness and confusion, with a feeling of weight and uneasiness in the stomach; later, depression and drowsiness, and eventually sleep. Tremors and even convulsive movements have been also sometimes noticed; the pulse is said to be accelerated and quickened.

Its effects appear to be very uncertain at best, and as most of the musk on the market is adulterated, there would seem to be very little reason for its employment. In addition it is an expensive medicament. Its therapeutic use has always been empirical, mainly in spasmodic conditions, such as chorea, whooping-cough, hiccough and laryngismus stridulus, and as a **stimulant in asthenic conditions,** especially in pneumonia and delirium tremens and in typhus and other fevers. At present it is most often, if at all, prescribed, for the extreme weakness which frequently follows typhoid fever.

Drugs Acting on the Vagus Center

ACONITE

For the Preparations of Aconite *see* p. 140.

Action of Aconite

The action of aconite is due to its principal constituent, aconitine, which is recognized as the most toxic of all known alkaloids.

External.—Locally it is an irritant, but, unlike other local irritants, it does not cause redness, blistering or other sign of inflammation for it is not a general irritant to protoplasm. Applied to the skin or mucous membrane, it soon affects the peripheral ends of the sensory nerves, causing itching, **tingling** and **burning.** This stimulation is followed by **numbness,** and later by complete **paralysis** of sensation in the part. Inhaled through the nostrils, it gives rise to **sneezing** and symptoms of coryza, with an **icy cold** sensation. Aconitine causes much pain if used hypodermatically.

Internal. *Gastro-intestinal Tract.*—When taken by the mouth it causes a disagreeable prickling and sense of constriction in the fauces. Other mucous membranes become affected, and various reflexes, such as sneezing, coughing, increased flow of saliva, nausea and vomiting, may be produced by the irritation of the sensory terminations. This stimulation is succeeded by a depression which gives rise to a sense of numbness in the different surfaces. Unless the dose is excessive, purging is not caused, and then only occasionally. The absorption is rapid from the alimentary tract.

Heart and Circulation.—The action of aconite on the heart is somewhat complex, and, if given in sufficient amount, it has the effect of successively stimulating and paralyzing all the different parts of the mechanism of the organ. After small doses the only symptoms produced are those due to stimulation of the vagus centers in the medulla, the primary action of the drug. As a result, the rate of the heart is **slowed,** the **diastole is increased,** the systole is diminished, and there is a **fall in blood-pressure.** That these effects are due to stimulation of the inhibitory centers is shown by the fact that if the vagus is divided the heart-beat returns to the normal. With larger doses the primary slowing action is the same, but this is soon followed by results due to the direct action of the drug upon the heart itself, as well as its influence upon the vaso-motor centers. The rhythm becomes markedly accelerated, instead of abnormally slow. This acceleration has been attributed to paralysis of the vagus terminals, but that it is not due entirely or principally to this is shown by the fact that it occurs after section of the vagus, or after the administration of atropine which paralyzes the vagus terminations. There is evidently a powerful stimulation of the cardiac muscle, and the action of the heart becomes not only very rapid but also extremely irregular. The blood-pressure likewise becomes exceedingly irregular, now falling

and now rising again to a considerable extent. The contractions of both the auricle and ventricle are imperfect and very unequal, one part often beating at a different rate from the other. The ventricular action tends to become more rapid than the auricular and the increasing irritability of the heart eventually results in delirium cordis. Finally the vaso-motor centers become paralyzed and lose their function. There is always in the end a complete fall in pressure from paralysis of the heart and blood-vessels. Clinically it appears that the peripheral vessels are dilated, and this effect is sometimes very marked. Aconite has been named the "vegetable lancet."

Respiration.—In moderate doses aconite usually has the effect of quieting the respiratory movements. Under toxic doses the respiration is at first quickened, but soon becomes very slow and labored. When the full effect of the drug is produced both inspiration and expiration are prolonged, and the latter is followed by a long pause. Between the primary quickening and the subsequent permanent slowing the respiration is sometimes very irregular, and from the first there is always marked dyspnœa. The respiratory disturbance is caused by the depressing action of the drug upon the respiratory center in the medulla; and this depression begins early. While it may sometimes occur that the heart ceases before the respiratory movements, but paralysis of the respiratory center, rather than cardiac paralysis, constitutes the usual cause of death in poisoning. In fact, if artificial respiration be practised, the heart will continue to beat after the respiratory center has ceased to act. The paralysis of this center progresses more quickly than that of any other, and it is possible, therefore, for death to take place from asphyxia while the rest of the central nervous system still continues irritable, as shown by the occurrence of convulsions.

Nervous System.—On the cerebrum it has apparently but little influence. In instances of poisoning by it the intellectual faculties are not affected, and consciousness usually remains to the end. If the latter is lost or impaired, this may be due to changes in the circulation and respiration, or possibly to collapse resulting from paralysis of the medullary centers. Near the end, carbon dioxide narcosis may supervene. Aconite has decided effects on the medulla apart from its action on the vagus center. It is also believed that it affects the vaso-constrictor center and that the vomiting so frequently present is due, at least in part, to increased irritability of the medullary cen-

ters. There is dilatation of the pupil, and this is due to stimulation of the central dilator apparatus, while the convulsions which are not infrequently observed are also attributed largely to stimulation of the medulla and spinal cord. The spasms have been thought to be chiefly respiratory, but the fact that they are not always relieved by artificial respiration indicates, an effect, in part, central. The action of aconite on the spinal cord has not as yet been definitely determined, but the reflex function of the cord is apparently impaired by it. Its action on the motor spinal cord, however, is believed to be entirely subservient to its influence on the peripheral nerves. It doubtless causes paralysis of the sensory nerves, commencing at their peripheral terminations and extending eventually to the center of sensation in the cord, and that the loss of reflex activity noted is due, at least in great part, to the peripheral paralysis; furthermore, that the motor nerves, upon which it exerts a feeble depressing influence, are not affected until after the sensory nerves. Under toxic doses of aconite the special senses may be more or less interfered with, and the general sensibility is always greatly diminished, so that marked **anæsthesia of the surface** is a prominent characteristic.

Temperature.—Attention has been called by certain observers to the peculiar and unique effect which aconite has of causing a chilly sensation which occurs before either the body temperature or the circulation through the skin is changed. Both in febrile conditions and in the normal state aconite has the effect of markedly **reducing** the **temperature.** It is not positively known in what manner this fall is brought about, but it seems probable that it is due in great part to the influence of the drug upon the nervous centers regulating heat production and to its action on the circulation. A considerable amount of radiation, it might be expected, would take place from the surface of the body in consequence of the lowering of the blood-pressure and dilatation of the peripheral vessels caused by it, and the increase of perspiration which is also one of its effects no doubt assists in the reduction of the temperature. The lessening of the supply of oxygen to the tissues occasioned by the interference with the circulation and respiration is shown by the cyanotic appearance of the mucous membranes, and this, it is believed, is largely instrumental in causing the fall.

Skin.—**Profuse sweating** is an almost constant symptom when large doses are taken. Whether it has any direct action on the per-

spiratory glands or not is not definitely known, but the dilatation of the cutaneous vessels, by increasing the blood-supply of the parts, facilitates an increased sudoriparous excretion. It is probable, therefore, that aconite does have some positive diaphoretic action, but, even if this is so the cold perspiration so commonly observed is largely attributable to the collapse induced by the drug. In occasional instances an erythematous rash is caused by it.

Kidneys.—Aconite has some minor influence on the kidneys. It thus increases elimination to a certain extent, and of both the watery and the solid constituents, of the urine. Aconitine is excreted mainly through the kidneys, slightly by the saliva, perspiration and bile.

Therapeutics of Aconite

External.—The benumbing effects of aconite when locally applied have suggested its external use in a variety of painful affections, and it is sometimes of considerable service, especially in **facial** and other **neuralgias.** Among the other conditions in which it has been employed are pruritus, prurigo, papular eczema, chilblains and herpes zoster. It is also used locally for the relief of the pain of so-called chronic rheumatism, gout and myalgia, applied in the form of the tincture.

Internal.—While aconite is contra-indicated in all instances where the heart is weak and in adynamic conditions in general, it has considerable usefulness, and probably at the present time it is not employed to as great extent as it really deserves. In the early stages of acute inflammatory diseases it often acts very happily, and the more promptly it is resorted to the greater will be the benefit derived from it. It **reduces** the **temperature** and the **arterial tension,** quiets the heart, allays pain by its influence on the sensory nervous system, and promotes elimination by its action on the skin and kidneys. By its additional effect of slowing the respiratory movements it is of special value in some of the acute affections of the organs of respiration, the work of which is thus materially lessened. Among the conditions in which it can be used with advantage, if administered sufficiently early, may be mentioned coryza, pharyngitis, tonsillitis, bronchitis, pleurisy, pericarditis, congestion and inflammation of the liver, peritonitis, inflammation of the cerebral or spinal

meninges, cerebro-spinal meningitis, and the active fever of acute cerebral congestion. It will be understood, however, its use should not be continued after effusion has taken place in the serous inflammations or after the febrile movement has abated in the others. The best preparation is the tincture, and the exhibition of this in small quantities at frequent intervals during the day, followed by a full dose of Dover's powder at night, is considered one of the best ways to "break up a cold." In catarrhal and fibrinous pneumonia it is more particularly useful before exudation has occurred. In acute pleurisy before the stage of effusion and in some other inflammations, notably peritonitis, great benefit may be derived by combining it with opium. In what are known as irritative fevers, especially among children, it is extremely useful in small and repeated doses, usually producing a free **diaphoresis** and prompt fall of the temperature. It has been commended in the early stage of scarlatina, as not only reducing the temperature and acting favorably on the skin and kidneys, but also checking the nasal, faucial and aural inflammations which often constitute such serious complications and sequelæ of the disease. In measles it sometimes serves the purpose of arresting the catarrhal pneumonia which is one of the most dangerous complications of this affection. One of the diseases in which it has been employed with the best effect is erysipelas of the non-traumatic variety, especially facial. Aconite may be of service in acute articular rheumatism when there is much heat and a dry skin, instead of the more common sweating, and if it is desirable to bring about a very free action of the skin it is recommended to combine it with pilocarpine and antipyrine.

In conditions in which there is **high arterial tension,** chiefly of cardiac origin, aconite is a remedy of the greatest value. It is especially indicated for patients without valvular disease in whom there is hypertrophy and over-action of the heart, and likewise when with valvular diseaset here is excessive compensation. For this purpose its use must be persisted in for months and even years. Many patients, whose blood-pressure is high, will live in comfort, so long as they employ aconite, the tincture being the preferable form of exhibition. It is particularly useful in cardiac neuroses. In simple nervous palpitation of the heart it is of great service, and it has sometimes also been found to relieve the pain of aneurism. While it has the power of allaying over-excitement of the sensory

nerves, it has little effect in relieving such affections as migraine, where the pain is of central origin. It has a certain amount of value in the treatment of neuralgias, but is generally less efficient when given internally than when locally applied, and is inferior in such affections to some other remedies at our command. In trigeminal neuralgia, while not affording relief in all, in a considerable proportion of instances it is found to be successful. It is of more or less service in acute maniacal delirium and other mental affections, where vascular excitement and high arterial tension are present, but gelsemium has proved more efficient in this class of patients. It sometimes has an excellent effect in controlling the vomiting of pregnancy, and this has usually been attributed to its influence upon the peripheral sensory system, but may perhaps be due to its action in benumbing the sensory reflex centers. It frequently acts well in acute suppression of the menses from cold, and it has been found a valuable remedy in congestive dysmenorrhœa in the full-blooded.

TOXICOLOGY

Symptoms.—If the dose is sufficiently large, death, probably due to cardiac paralysis, may occur almost instantaneously. When the quantity taken is smaller, the effects of the drug are soon felt. The characteristic burning and prickling in the mouth, followed by a sense of numbness, extends to the stomach, and eventually to the skin. There is a profuse flow of saliva and in some instances vomiting, while the cutaneous surface becomes covered with a cold sweat. The pulse, at first is slow as well as feeble, may afterward become very rapid and scarcely perceptible. The respiration is labored, shallow, and accompanied by marked dyspnœa. The patient's face is pale and anxious and there are great restlessness and general distress, with a sense of extreme fatigue and a loss of muscular power. With tingling and numbness in the extremities and more or less over the surface, there is a diminished sensibility to pain. The pupils remain dilated. Consciousness is not lost until the final collapse. Convulsions frequently precede death, which is generally due to paralysis of the respiratory center, perhaps aided by anæmia of the medulla, but may be caused by paralysis of the heart. Under lethal doses the fatal result usually occurs in from two to six hours.

Post-mortem.—The appearances met with are not constant, but are generally such as are characteristic of death from asphyxia.

Treatment.—Emetics may be tried, but will probably fail on account of the benumbed condition of the gastric mucous membrane. If the symptoms are very severe, it is better not to attempt to excite vomiting, on account of the risk of its causing fatal syncope. The stomach must therefore be evacuated by means of a stomach-pump or tube. The patient should be kept flat on his back, with the

feet somewhat higher than the head, and artificial respiration should be resorted to as soon as difficulty of breathing occurs. His body should be wrapped in blankets and hot water bottles applied to the soles of the feet, or other means employed to maintain the temperature. Tannic acid is, to some extent, an antidote to aconite and may be tried; but is not to be depended upon. The main reliance must be upon stimulation. By the mouth ammonia and alcoholic stimulants may be administered, and for hypodermatic use it is recommended that ether, alcohol, and digitalis be given in the order named; the ether acting most promptly and supporting the heart until the alcohol can be absorbed, and the alcohol continuing the support until the digitalis, which is the physiological antagonist of aconite, but acts slowly, has had time to produce its effects. In addition, strychnine should also be given subcutaneously in full doses, as a stimulant to the heart and respiration. If the patient seems to require it, ammonia may be injected into the veins, and the inhalation of amyl nitrite may be cautiously employed. Other agents which partially antagonize the effects upon the heart and respiration are caffeine and atropine.

VERATRUM VIRIDE

For the Preparations of Veratrum Viride *see* p. 142.

Action of Veratrum Viride

The alkaloids of veratrum have been the subject of considerable discussion, but the latest opinion is that the activity of the drug is really due to cevadine which is the principal constituent of the official veratrine which is obtained from an entirely different plant. The latter has a chemical composition similar to aconitine, and has practically the same action on the central nervous system and the sensory terminations, but is, in addition, peculiar in prolonging the relaxation of striped and cardiac muscle, which is known as "veratrine action," and, which is entirely absent in aconitine poisoning. The action of veratrum and veratrine may, therefore, be considered together.

External.—Applied to the skin veratrine, and to a less degree the drug itself, although it contains an acrid resin, produces a feeling of warmth and prickling, followed by a sensation of coldness and by numbness and anæsthesia. Applied to the mucous membrane of the nose and throat, it causes **violent sneezing** and **coughing**, and a minute portion placed upon the tongue gives rise to burning pain and free **salivation.** These phenomena, as with aconite, are due to **stimulation** of the peripheral endings of the **sensory nerves.**

Internal. *Gastro-intestinal Tract.*—When full doses are taken there are produced burning in the mouth, which spreads to the stomach, well-marked salivation, **nausea** and **vomiting,** and generally **purgation** accompanied by severe colic. The retching and vomiting, which are violent and persistent, have been attributed by some to central action and by others to irritation of the sensory nerve endings, and it seems probable that both of these are concerned in their causation.

Muscles.—There is marked prolongation in the relaxation of muscles after contraction, which takes place normally, but is more complete than under ordinary circumstances. If a tracing be taken of the contraction of a muscle it will be seen that the height of the contraction is slightly increased, and that instead of the almost instantaneous return to the base-line seen in the normal tracing, the curve shows generally a slight undulation and then a very slow fall, the period of relaxation being from twenty to thirty times as long as in the unpoisoned muscle. This prolonged relaxation would at first sight appear like tetanus, but is entirely free from any element of spasm or rigidity. It has been found that it is accompanied by an increased formation of heat in and waste of tissues, and that it is lessened by fatigue, cold and other muscle depressing agents, while increased by moderate heat. It must therefore be looked upon as an expression of greater functional activity, a **prolonged contraction** rather than a loss of elasticity. The irritability and absolute strength are also increased, so that the muscle reacts to weaker stimuli and contracts against a greater weight than usual. That the phenomena noted are not due to any nervous influence is shown by the fact that excised muscles show exactly the same reaction.

Heart and Circulation.—The principal cardiac effects observed are due to the influence exerted upon the medullary centers. As is the fact with aconite, there is a primary stimulation of the vagus center, resulting in a **slowing** of the heart's rate and a **reduction of arterial pressure.** At the same time, constriction of the peripheral vessels is produced through stimulation of the vaso-motor center. After larger quantities the pulse is accelerated, the vaso-motor center being depressed and the terminations of the vagus paralyzed. If the posture is changed from the recumbent to the upright, the pulse at once becomes extremely rapid and thready.

Respiration.—The effects on respiration, due to depression of the respiratory center in the medulla, are much the same as those of aconite. The breathing is slow and labored and attended with dyspnœa, and after lethal doses death usually results from paralysis of respiration.

Nervous System.—That the drug has decided action on the medullary centers has already been noted. It also has a stimulating effect on the spinal cord, but the influence exerted by it on the highest cerebral centers is probably but slight, though the convulsions produced by it are believed, as is the fact with aconite, to be due to central stimulation. It acts to some extent on the motor nerves, and its effects on the sensory nerve endings have been previously mentioned. After large doses the stimulation of the central and peripheral nervous system is succeeded by paralysis.

Skin.—It produces **free sweating,** but this is probably the result of arterial depression, rather than of any specific diaphoretic action.

Temperature.—There is generally under its influence a considerable reduction in temperature, which is thought to be due to the increased heat-dissipation resulting from vaso-motor paralysis and the slowing of the circulation. When, however, the convulsions are marked, increased heat-production is caused by the violent movements, and the temperature is even higher than normal.

Therapeutics of Veratrum Viride

External.—Veratrine, in 2 per cent. solution in equal parts of olive oil and oleic acid, is chiefly employed, either alone or in combination with other remedies, in the external treatment of neuralgia, myalgia, herpes zoster, acute gout, and other **painful affections,** and for chronic swelling and stiffness of the joints. In the external application of veratrine preparations care should always be taken to avoid abrasions of the cuticle, on account of the danger of absorption. They should likewise be used with caution near the eye, as violent inflammation of the conjunctiva will be set up if any of the veratrine comes in contact with it.

Internal.—Veratrine is very rarely given internally, doubtless because dangerous symptoms have followed the administration of comparatively small doses.

Veratrum viride is a prompt and sure **circulatory depressant,** and

There may or may not be muscular twitchings. After veratrine especially the convulsive movements are sometimes very marked. There is extreme debility, the features are pinched, and there is usually great pallor, with a cold and clammy skin. The medullary and spinal centers become paralyzed, and death results from respiratory collapse, adjuvated by failure of the circulation. The *post-mortem* changes are not characteristic.

Treatment.—The treatment is practically the same as in aconite poisoning (*see* p. 460) although the contents of the stomach are usually efficiently evacuated by the action of the drug itself. Atropine has proved of some value in the poisoning of animals by veratrine, and its use is suggested on account of its action on the respiratory center and on the vagus terminations in the heart. As the poison is rapidly excreted through the urine it has also been recommended to administer hot tea as a diuretic.

DIVISION IV.—DRUGS ACTING ON THE VESSELS

These effects are usually determined (1) by direct observation of alterations caused by the drug in the size of the vessels of some thin structure, such as the ear of the rabbit, the wing of the bat, or the web, lung, mesentery, tongue or mylo-hyoid muscle of the frog; (2) by observing the rate at which the blood flows from the cut vessel of an animal, both under and without the influence of the drug. In order to exclude influences acting on the cardiac mechanism, the maintenance of an artificial circulation is quite commonly resorted to, and destruction of the spinal cord or section of the nerves supplying the part is required to determine whether the changes observed are due to local or central effects. When alterations in the vessels result from the local application of a drug it is often uncertain, if the nerves supplying the part are not divided, whether the effect is reflex or direct. It is probable that some of the drugs act by the vaso-constrictor and some by the vaso-dilator nerves, both of which connect the vessels with the central nervous system; but they can only be classified generally into those drugs which dilate or constrict the vessels by local action and those which do so through their action on the central nervous system. In those acting locally it is impossible to determine whether they affect the muscular coat of the vessel or the nerve terminations. It can readily be seen that drugs which act on the heart or on a large area will have a considerable

effect upon the general blood-pressure. Drugs are applied to the interior of vessels by injecting them into the circulation.

A. Drugs acting locally on Vessels.

1. Vaso-dilators.

a. Drugs which, when locally applied to vessels, dilate them:

(1) **Solutions of ammonia.**
(2) **Silver nitrate**
(3) **Zinc chloride** } (strong).
(4) **Copper sulphate**
(5) **Mercuric nitrate.**
(6) **Arsenic trioxide.**
(7) **Antimony and potassium tartrate.**
(8) **Iodine.**
(9) **Chlorine.**
(10) **Mineral acids** (strong).
(11) **Alcohol.**
(12) **Ether.** } If prevented from evaporating.
(13) **Chloroform.**
(14) **Phenol.**
(15) **Cresote.**
(16) **All volatile oils,** as oil of turpentine, and many substances containing them, as mustard, etc.
(17) **Senega.**
(18) **Chrysarobin.**
(19) **Ipecac.**
(20) **Capsicum.**
(21) **Croton oil.**
(22) **Camphor.**
(23) **Cantharides.**
(24) **Phosphorus.**

Irritants.—Since they dilate the vessels, these drugs are often spoken of as **vascular irritants.** Warmth, if transiently applied dilates, but if for a long time, contracts blood-vessels.

Rubefacients.—These are drugs which, in consequence of the vascular dilatation caused by them, redden the skin when they are applied to it. Desquamation frequently follows if the action has continued for some time. All the above are rubefacients.

Vesicants.—With many of these drugs the irritant effect is sufficient to produce inflammation, and when they cause the exudation of serum between the epidermis and the true skin and the formation of vesicles or blisters they are known as vesicants; *e.g.*, cantharides.

Pustulants.—These are drugs which produce small discrete suppurations, the distinct and separate points of inflammation being situated at the orifices of the skin glands. They do not affect the intervening tissue, probably for this reason that they cannot pass through the horny epidermis; *e.g.*, croton oil.

Escharotics.—With the most powerful of these drugs the irritation is sufficient to destroy the vitality of the tissues with which they came in contact, forming a slough, and to cause vascular dilatation in the surrounding parts. They are known also as **caustics**; *e.g.*, zinc chloride.

Counter-irritants.—When any of these drugs are employed to produce a reflex influence on a part more or less remote from the point of application, they are termed counter-irritants. The exact nature of the effects of counter-irritation on internal organs has not been determined, but it is considered most probable that an alteration in the caliber of the vessels and in the sensory nerves or their terminations is induced, and that such changes may cause or be accompanied by a distinct alteration in the activity of the organs

b. Drugs which, when inhaled, by acting locally, dilate peripheral vessels:

(1) **Amyl nitrite.**
(2) **Nitroglycerin.**
(3) **Sodium nitrite.**
(4) **Spirit of nitrous ether.**

c. Drugs which, when taken by the mouth, by acting locally, dilate peripheral vessels:

(1) **Amyl nitrite.**
(2) **Nitroglycerin.**
(3) **Sodium nitrite.**
(4) **Spirit of nitrous ether.**
(5) **Belladonna.**
(6) **Hyoscyamus.**
(7) **Stramonium.**

From a medical standpoint these are the most important of the vaso-dilators.

2. Vaso-constrictors.

a. Drugs which, when locally applied to vessels, constrict them:

These may act in two ways: (1) By contracting the muscular coat of the vessels; and (2) by coagulating the albuminous fluids around them, the coagulum, by its contraction, constricting the vessels.

Those which act on the muscular coat of the vessels:

(1) **Cocaine.**
(2) **Dried suprarenal.**
(3) **Lead salts.**
(4) **Silver salts** (dilute solutions).
(5) **Diluted sulphuric acid.**
(6) **Alum.**
(7) **Hamamelis.**
(8) **Hydrastis.**
(9) **Acetanilid.**
(10) **Antipyrine.**

Cold, temporarily applied, contracts, but when long continued, dilates blood-vessels.

Those which coagulate the albuminous fluids around the vessels:

(1) **Tannic acid** and all substances containing it: *e.g.*, nutgall, kino, cinnamon, and gambir.
(2) **Lead salts.**
(3) **Silver salts.**
(4) **Zinc salts.**
(5) **Copper salts.**
(6) **Alum.**
(7) **Ferric salts.**
(8) **Bismuth salts** (slightly).

Astringents.—These are drugs which diminish the size of the vessels, and thus decrease the amount of exudation from them. They

produce contraction of muscular fiber by direct irritation and condensation of other tissues by precipitating albumin and gelatin.

b. Drugs which, taken by the mouth, contract arterioles by acting locally on them:

(1) **Ergot.**
(2) **Digitalis.**
(3) **Squill.**
(4) **Physostigmine.**
(5) **Dried suprarenal.**
(6) **Veratrine.**

The following have been shown by experiment to cause contraction of small arteries through which they circulate: copper and zinc salts (powerful); lithium, calcium, strontium, magnesium, and iron salts (weak).

Styptics, or **Hæmostatics.**—These are drugs which stop bleeding. Among them are included all astringents, the most important of them being cold, lead and copper salts, hamamelis, ergot, hydrastis, tannic acid, and especially ferric salts, which coagulate escaping blood, while the clot thus formed tends to prevent further hæmorrhage.

3. Emollients and Demulcents.

Emollients.—These are substances which soften and relax the parts to which they are applied. They serve to relieve tension, diminish pressure on the nerves, and also protect inflamed surfaces from the air and from friction.

Common emollients are substances saturated in warm water, as hot fomentations and poultices, fats of various kinds, as lard and hydrous wool-fat, and non-irritating oils, as olive oil, petrolatum, spermaceti, etc.

Demulcents.—These are substances which protect and soothe the tissues to which they are applied, and are often of a mucilaginous nature. This term, is ordinarily employed for substances used for mucous membranes and that of emollient for those used for the skin. Among demulcents may be mentioned gelatin, glycerin, honey, flaxseed and starch.

Therapeutics.—Drugs which locally dilate vessels are frequently used as stimulating applications for indolent ulcers and sores, as well as to promote the absorption of inflammatory products; also as counter-irritants in various diseased conditions in internal organs. Drugs such as the nitrites, which by their central action cause dilatation of all the vessels of the body, are employed in cardiac diseases, where the relief which they afford is no doubt largely due to their thus diminishing the work of the heart. Others having this general vaso-dilator action are used more particularly to cause diaphoresis.

Astringents are used chiefly as styptics, but also to diminish secretion from mucous membranes and check excessive discharges generally, as well as to obviate relaxed vascular conditions.

B. Drugs which act on the Vaso-motor Centers.

Drugs which, by their action on the vaso-motor centers, dilate the vessels:

(1) **Alcohol.**
(2) **Ether.**
(3) **Chloroform.**
(4) **Hydrated chloral.**
(5) **Aconite.**
(6) **Ipecac.**
(7) **Veratrine.**
(8) **Hydrocyanic acid.**
(9) **Opium.**

Some of the substances which in small doses contract the vessels by central action, in large doses dilate them; viz., digitalis and squill.

Drugs which, by their action on vaso-motor centers, cause contraction of vessels:

(1) **Ergot.**
(2) **Digitalis.**
(3) **Strophanthus.**
(4) **Squill.**
(5) **Physostigmine.**
(6) **Cocaine.**
(7) **Hydrastis.**
(8) **Strychnine.**

Also, for a short period of their action, some substances whose main action is to dilate the vessels by their central action; viz., belladonna, stramonium, and hyoscyamus.

A. Drugs Acting Locally on the Vessels

1. Vaso-dilators. (*a*) Acting locally.

THE ACIDS

For the Preparations of the Acids *see* p. 50.

Action of the Acids

External.—Sulphuric, nitric, hydrochloric, phosphoric, acetic, citric, tartaric and lactic are powerful local **irritants**; the least so is citric. While its concentrated solution does not affect the sound skin, it is irritant to mucous membranes and abraded surfaces. Next to this comes tartaric, the saturated solution of which acts upon the unabraded skin, and when applied to a raw surface produces irritation, with pain and heat. The remaining acids are very energetic **caustics**, and even when in very dilute solution cause an irritation which may amount to vesication. The nature of the escharotic action varies to some extent, but, on the whole, is found to consist in

withdrawal of water, the formation of acid albumins, softening of the connective tissue and epithelium, and, in special situations, solution of calcareous material. The most typical acids in regard to the local action are sulphuric and hydrochloric. Nitric causes the same effects, but owing to the fact that it does not redissolve the albumin it precipitates, its area of action is limited; nitrohydrochloric is very energetic. Nitric acid stains the skin a deep yellow and causes a yellow eschar, while sulphuric, in consequence of its leaving the carbon untouched, blackens the surface and causes a brown or black eschar. The latter causes necrosis of the skin and subcutaneous tissues, which is accompanied by intense pain and, if the surface involved is large, by symptoms of shock and collapse such as are met with in severe burns. Hydrochloric acid, though less liable to entirely destroy the skin, penetrates the epidermis and causes vesication. Phosphoric is considerably less irritant, but causes redness and even blistering when applied in concentrated solution. Glacial acetic acid is especially applicable when a limited action is desired. The corrosive action of the acids is much more intense upon mucous membranes than upon the skin, and even small quantities of strong sulphuric acid applied to the eye are sufficient to destroy the sight.

As all the more powerful acids unite with and **coagulate albumin** they act as **astringents** and **hæmostatics**, both by coagulating the blood and by coagulating the albumin in the tissues, with the effect of constricting the vessels. Weak solutions, moreover, are cooling to the skin in febrile conditions, and hence they are classed also as **refrigerants**. As most living matter is neutral or slightly alkaline in reaction, and incapable of existing in acid media, the acids are protoplasmic poisons and antiseptics of some power.

Alimentary Canal.—In the mouth, œsophagus and stomach complete destruction of the mucous membrane results from the corrosive action of strong acids wherever they come in contact with it. As in the fact with the caustic alkalies, perforation of the œsophagus or stomach may be produced, causing immediate death, with symptoms of shock and collapse, or if the corrosion does not go to this extent, cicatrices may result which eventually result fatally. While hydrochloric and the stronger organic acids are capable of causing corrosion, this is not usually so extensive as that produced by sulphuric and nitric acid. In the mouth the diluted acids have a characteristic pungent taste, as popularly expressed, "set the teeth on edge."

They also soften the dental enamel. The saliva being alkaline, they augment its secretion, and thus serve to allay thirst by keeping the mouth moist. In the mouth they cause an astringent feeling in consequence of their coagulating the superficial layers of proteids. When the gastric juice is deficient in acid, acids taken after a meal, by remedying this, assist digestion, but if given before or during meals they tend to check the flow of the gastric juice. As the latter contains hydrochloric acid, this is undoubtedly the best for administration when the amount of acid secreted is deficient. Since pepsin is excreted in actual combination with the hydrochloric acid, it would seem to be impossible to completely replace the deficiency of acid in the stomach by giving hydrochloric acid by the mouth. The prolonged treatment of animals with acids has been found to be followed by anæmia and loss of flesh and strength, attributable to the disturbance of the digestion induced. If free acid penetrates into the intestinal canal it acts as a very powerful irritant and produces increased peristalsis. As a rule, acids quickly become converted into neutral salts, but some, especially sulphuric, preserve their astringent action in the intestine. According to some, the increased flow of pancreatic juice and of bile which has been ascribed to acids is probably too small to be of value, but others are convinced that they materially increase the amount of bile poured into the intestine, this being notably the fact with nitric acid, while nitrohydrochloric acid is not only a cholagogue, but also a hepatic stimulant of considerable power.

Absorption and Excretion.—Generally the acids are absorbed from the alimentary canal with considerable rapidity. The salts formed in the blood and tissues after their absorption are quickly excreted by the kidneys. The latter, it is found, retain as much alkali as possible in the body, and the result is that they excrete the salts in an acid form, and perhaps some free acid. Consequently, irritation of the kidneys is sometimes induced, with albumin and even blood in the urine, which is rendered more acid than usual and causes a sensation of smarting in the urethra. Nitric acid, however, may be excreted to a small extent as ammonia, and hence slightly to increase the alkalinity of the urine, which may be also increased by acetic, citric and tartaric acids, in consequence of their being converted into alkaline carbonates in the blood. Lactic acid is either so converted or passes out as carbon dioxide in solution in the urine.

Blood.—Acids may have the effect of reducing the alkalinity of the blood, but the reaction of this fluid must necessarily remain slightly alkaline throughout life. It has been found that the red blood-corpuscles are increased in size by the addition of small quantities of acid outside the body, and the amount of phosphates in these cells is believed to be increased by the administration of phosphoric acid. In chlorosis it is stated that the number of the red corpuscles will be increased by hydrochloric acid, though the amount of hæmoglobin remains unaltered.

Therapeutics of the Acids

External.—Owing to their marked affinity for water, it is difficult to limit the local action of sulphuric and phosphoric acids, and consequently nitric acid is much more commonly employed as a caustic. It is the preferable **escharotic** for venereal sores, warts, poisoned wounds, phagedæna and cancrum oris. Glacial acetic acid is successfully used for warts, corns, ulcers, lupus, epithelioma and nasal hypertrophies, as well as for ringworm and other forms of tinea. If much pain is occasioned it may be more or less diluted.

Trichloracetic acid (*see* p. 99) is employed in lupus and condylomata, and as a **caustic** in diseases of the nose and throat. It penetrates deeply, but causes less pain than many other escharotics. Hydrochloric acid is sometimes applied to septic wounds, and bites of rabid animals, and in combination with pepsin has been utilized for the removal of carious and necrotic bone. The undiluted acid has been successfully employed as a counter-irritant in sciatica, painted with a small brush along the course of the nerve, after which the part is wrapped up in cotton. The application may be repeated in twenty-four or forty-eight hours, as required. Lactic acid is employed, perhaps more frequently than any other drug, as a local application in tuberculosis of the larynx. It is customary to begin with the following: lactic acid, 2; water, 1; glycerin, 1; which is applied with a brush. The strength of the solution is then gradually increased until at length the pure acid is used. Any well-diluted acid may be applied to arrest slight bleeding, as from leech-bites, hæmorrhoids, etc. Dilute vinegar will often answer, but sulphuric acid is particularly useful for this purpose, and its astringent effect is also made use of locally in the night-sweats of phthisis. Vinegar, properly diluted, is often employed as a refrigerant for bathing the skin in fever.

Internal. *Alimentary Canal.*—In consequence of the injurious effect of acids upon the teeth, it is better that they should be taken through a glass tube. Dilute sulphuric acid is used to a considerable extent as a remedy for **lead poisoning**, and as a prophylactic measure, a lemonade made with sulphuric acid is quite commonly taken by those employed in lead works and paint factories. This is recommended on the ground that the lead taken into the system is by this means changed to the insoluble sulphate and is thus less easily absorbed. It has been found in practice that dilute sulphuric acid is effective in the treatment of lead-colic and that the constipation due to lead is relieved by a combination of sulphuric acid and magnesium sulphate, while the lead-cachexia is much benefited by sulphuric acid given in association with quinine and ferrous sulphate. On the other hand, sulphuric acid is of no service in removing the effects of lead upon the nervous system. Aromatic sulphuric acid, sufficiently diluted with water and syrup, makes a pleasant cooling drink for fever patients. In gastric and intestinal hæmorrhage it acts directly in part, and may therefore prove useful and on account of its astringent effect, it is often of great value in diarrhœal conditions. Sulphuric acid, being decidedly astringent, is as a rule, to be preferred to nitric and hydrochloric acids in the treatment of diarrhœa, but the latter are useful also, and the mineral acids as a class are very efficient remedies in colliquative diarrhœa, whenever the stools are painless, watery, of a light color, and alkaline in reaction.

As regards the action on the economy, of the three principal mineral acids, the general statement has been made that sulphuric promotes astringency; nitric, secretion; and hydrochloric, digestion. A very useful combination consists of nitrohydrochloric acid with tincture of nux vomica and some other stomachic tonic, as the compound tincture of gentian. Hydrochloric acid is sometimes useful, in association with other remedies, in instances of diarrhœa which are characterized by excessive putrefaction of the intestinal contents. As a result of its administration the double sulphates of the urine are in many instances lessened; so that it would seem probable that it has the effect of **disinfecting the stomach contents**, as the hydrochloric acid of the gastric secretion does normally. In that variety of dyspepsia in which acid eructations, pyrosis, and heartburn occur acids are of decided service, particularly hydrochloric and phosphoric, and they should then be administered before meals. Hydrochloric

acid is given to a very considerable extent in typhoid fever, where by increasing the secretion of mucus it relieves the dryness of the tongue and fauces, and where it also no doubt tends to disinfect the intestinal contents. If the diarrhœa is troublesome, sulphuric acid may be given in its place. In many instances nitrohydrochloric acid seems to act very satisfactorily, and it is particularly indicated when the biliary function needs stimulating. Its special value is believed to be in **hepatic disorders** and jaundice. Its mode of action in such conditions is not definitely known, but its peculiar composition may possibly afford some explanation. This acid contains not only nitric and hydrochloric acid, but a number of decomposition products, such as chlorine, nitroxychloride (NOCl), and nitrous acid. The acids, as has been stated, are incapable of acting as such except in the alimentary canal, but it may be that some of the other constituents of this compound, as the chlorine, for instance, have a specific effect on the liver. Duodenitis and catarrh of the gall-ducts accompanied by jaundice are among the affections which have been found to be benefited by it, and the experience of physicians practising in tropical countries has been favorable to its use in chronic affections of the liver, as well as in dysentery and dropsy of hepatic origin.

Phosphoric acid is sometimes used to make cooling draughts in fever, as well as to relieve the thirst in diabetes. Acetic acid in the form of vinegar is a popular remedy for obesity, but its free use, however, is attended with more or less serious consequences, as it reduces flesh merely by interfering with the digestion. The prolonged administration of large quantities of acids usually proves irritant, and thus, by setting up a certain amount of gastritis, hinders the digestion and absorption of food. In order to allay the thirst of fever patients lemon juice or citric acid itself is used to stimulate the secretion of saliva and keep the mouth moist, and lemonade is a common beverage in febrile diseases. One or the other of these substances thus frequently serves as the basis for cooling drinks, and the acid is largely employed, together with alkaline carbonates, in the preparation of effervescing mixtures which are useful as gastric sedatives. Citric and tartaric acids also form ingredients of various granular effervescent preparations.

Remote Effects.—With the exception of citric, tartaric and acetic acids, the remote effects of the acids are of comparatively little therapeutic importance. Nitric acid has also been found of service,

after the arrest of the paroxysms of intermittent fever by quinine, in removing the hepatic congestion and the changes in the glandular apparatus of the intestines induced by the fever-movement. Both nitric and nitrohydrochloric acids have been used, internally as well as in the form of baths, in such diseases of the skin as impetigo, acne and erythema nodosum, while sulphuric acid, also employed internally and locally, is more or less effective in lichen, prurigo, and itching conditions in general. When uric acid is in excess in the urine from faulty digestion and assimilation, nitric acid is often of great service; the excess of uric acid disappearing in consequence of the foods being more adequately digested. Nitrohydrochloric acid is usually a very efficient remedy in **oxaluria**, a condition which seems to be dependent upon defective primary assimilation and is characterized by general malaise, a feeling of weakness, great mental depression, a sallow complexion, and often eructations of offensive gas, together with the presence in the urine of crystals of calcium oxalate. Citric, tartaric and acetic acids may be given in small doses to increase the alkalinity of the blood and through their conversion into alkaline carbonates to render the urine less acid. For an effervescent solution of citric acid about 8 parts of the acid may be prescribed with 7 parts of sodium bicarbonate, with directions to dissolve the two powders separately, mix the solutions, and drink while effervescing. In large quantities this mixture acts as a saline cathartic. There is no doubt as to the value of lemon and lime juice in the prophylaxis and treatment of **scurvy**, not alone due to the citric acid, but to some unknown property of the fruit juices. Orange juice has proved completely successful in the cure of infantile scurvy. Mineral acids, if their administration is too prolonged, tend to impair the appetite and disturb digestion, causing gastric oppression, and sometimes salivation and diarrhœa. In addition, they are liable to produce loss of flesh, paleness of the skin, and anæmia. If taken for long periods in comparatively large quantities they may induce degenerative changes in such organs as the heart, liver and kidneys, as well as give rise to the production of methæmoglobin in the blood. In large doses continued over considerable periods of time, citric, tartaric and acetic acids not only do not diminish the alkalinity of the blood but, by provoking intestinal fermentation, produce indicanuria and general acidosis. This has been observed

in instances of the employment of tartaric or citric acids, in the treatment of obesity.

TOXICOLOGY

In toxic doses all these acids are severe gastro-intestinal irritants. Tartaric, citric, and lactic acids are very rarely taken as poisons.

Symptoms.—These are intense, burning pains in the mouth, throat, stomach and abdomen, difficulty in swallowing, extreme thirst, and violent vomiting; the ejected matter containing blood and sometimes shreds of mucous membrane. Not infrequently there is diarrhœa, the stools showing a dark discoloration from the presence of blood. Some of the acid is likely to get into the larnyx, causing swelling and consequent dyspnœa, from obstruction to respiration. Evidences of shock and collapse, quickly develop. The respiration is shallow, the pulse rapid and weak, and the skin, which shows marked pallor, covered with a cold sweat. The temperature falls below normal, and death usually occurs within a few hours. When fuming acids are swallowed, and especially in poisoning with hydrochloric acid, the irritant vapor, passing into the respiratory passages, may cause spasm of the glottis or œdema of the larnyx, with the result of an immediately fatal issue from asphyxia. It has been found that so small a proportion of hydrochloric acid vapor as 1 part in 20,000 of air causes sneezing and pain in the throat and chest.

Post-mortem.—There are the characteristic evidences of corrosive poisoning in the mouth, œsophagus and stomach, with or without perforation, and sometimes extending into the intestine. The sloughs resulting from the destruction of the mucous membrane are of a whitish-gray color, and hæmorrhages are frequently met with. When death has been delayed for some time fatty degeneration of the heart, muscles, liver or kidney may be found, and in these patients necrosis of the renal cells has sometimes been observed.

Treatment.—Alkalies should be given at once to neutralize the acid, though there is a possibility that the stomach may be ruptured by the carbon dioxide gas generated from the combination thus formed. The best antidote is the insoluble magnesium oxide or carbonate, because these are not themselves corrosive, but if neither is procurable almost any accessible alkali may be resorted to, such as lime, chalk, soap or wood ashes. Then demulcents may be given, such as milk, white of egg, oil and flaxseed tea, which are useful in protecting the walls of the œsophagus and stomach; and the acid may be rendered less corrosive by diluting it with large quantities of water. If strong sulphuric or nitric acid has been swallowed, the stomach-tube should not be employed, on account of the danger of its extremity passing through the softened walls of the œsophagus or stomach; otherwise the stomach should be washed out. Morphine may be injected hypodermatically to relieve pain, and brandy or other stimulants used in the same way to counteract collapse.

CHROMIUM

For the Preparations of Chromium Trioxide *see* p. 87.

Action of Chromium Trioxide

External.—Chromium trioxide is a **powerful caustic.** By reason of its oxidizing power it is also an energetic disinfectant. When applied in substance it corrodes the tissues, but causes much less pain than the more penetrating caustic potash. Even in dilute solution it is an irritant to the skin, producing ulcerations, and workmen in factories, where chromic acid is used, are liable to suffer from perforation of the nasal septum from the local action of the acid applied accidentally.

Eczema of the hands, moreover, is said to occur in those who prepare the solution of potassium dichromate, used for dyeing purposes, and material dyed with the latter may produce ulceration of the integument.

Internal.—Chromium trioxide, in small doses and well diluted, is readily absorbed from the stomach and intestine. It appears to be excreted principally through the kidney, and to a less extent through the intestinal epithelium.

Therapeutics of Chromium Trioxide

External.—A lotion of chromium trioxide of the strength of 1 per cent. is used in Germany to toughen the feet of marching soldiers. On account of its **disinfectant** properties it is employed in the form of a lotion, 1 to 40, or even stronger, for cleansing foul ulcers and as a local application, in various dilutions in gonorrhœa, ozæna, severe ulcerations of the mouth, etc. A solution of the strength of 1 to 48, applied once or twice a day, is an excellent remedy for syphilitic mucous patches. For parasitic skin diseases, such as sycosis, lupus and tinea circinata, a solution ten times the strength of this may be employed.

Internal.—Chromium trioxide is never employed internally for medicinal purposes because of its well-marked irritant and corrosive properties.

TOXICOLOGY

Symptoms.—The symptoms produced by large quantities are those of gastro-intestinal corrosion, intense pain in the throat and stomach, vomiting and purging, with blood in the vomited matter and the stools. In mammals weakness is caused, and albuminuria, diarrhœa and vomiting, collapse, and frequently death,

follow. Sometimes twitching of the muscles or even convulsions are observed, and then the weakness passes into general paralysis. The heart appears to be little affected, but the blood-pressure falls. *Post-mortem.*—The lesions met with are those of corrosive poisoning, and the mouth and throat show a characteristic yellow discoloration. The stomach and intestine are found congested, while the mucous membrane is necrosed and ulcerated in some parts and covered with ecchymosis in others. Hæmorrhages are also found in other organs, and particularly in the cardiac wall, and parenchymatous nephritis is met with. In chronic poisoning interstitial nephritis is said to occur.

Treatment.—In poisoning by chromium trioxide, soap, an alkaline carbonate, or heavy magnesia, together with milk, may be given at once, and the stomach washed out.

OIL OF TURPENTINE

For the Preparations of Oil of Turpentine *see* p. 216.

Action of Oil of Turpentine

External.—Oil of turpentine has the characteristic action of the volatile oils in general. On the skin it acts as a **rubefacient, irritant** and **counter-irritant,** and its prolonged application may give rise to vesication or even ulceration. The effects are more marked if it is applied with friction. Under its external use, then, we find produced tingling, a feeling of warmth, and reddening of the surface, all of which result from the local dilation of blood-vessels caused by it. On mucous membranes there is found the same irritation, with redness and congestion, pain and smarting. Applied to fresh wounds, it is hæmostatic, contracting the blood-vessels and aiding coagulation. It is a fairly energetic antiseptic, and it is less irritant than many of the more powerful ones. It is absorbed from the unbroken skin.

Internal. *Alimentary Canal.*—Kept in the mouth, it causes the same redness and irritation of the mucous membrane, and is apt to excite a reflex excretion of saliva. In the stomach it gives rise to a feeling of **warmth** and comfort and causes some **reflex stimulation** of the heart. It also acts as a **carminative,** accelerating peristalsis and diminishing flatulence and distention, and its antiseptic action may be important in the production of this result. It is **anthelmintic,** and in sufficiently large doses **cathartic,** the fæces often containing blood.

Circulation.—It appears to produce a very slight rise of arterial pressure, increased pulse-rate, and **increased cardiac force.** The drug is known to have **hæmostatic** properties, due to its power of con-

tracting the vessels. After a large dose the stimulation is followed by depression, the action of the heart growing feeble, the blood-pressure falling, and the vessels dilating.

Nervous System.—In its action on the nerve cells, it differs from some of the other volatile oils in that the preliminary stimulation caused by large amounts is only transitory, being quickly followed by marked weakness and depression, with heaviness, unsteady gait and drowsiness. Toxic doses are said to cause paralysis of sensory nerves, loss of reflex action, insensibility and coma. The depression of the respiratory center in the medulla is preceded by stimulation, the breathing increasing in rapidity and volume.

Respiration.—Oil of turpentine is in part excreted by the bronchial mucous membrane, and during the course of this excretion it exerts an action on the respiratory passages which may be at once **stimulating** and **antiseptic**, and turpentine may also diminish the bronchial secretion in a specific manner. When **inhaled**, the vapor of oil of turpentine has the same **irritating** effect on the bronchial mucous membrane, as when applied directly to other mucous membranes and to the skin.

Kidneys.—It is largely excreted by the kidneys, its action upon these organs being more energetic than that of almost any other volatile oil and results especially in **diuresis.** Large doses are very irritant, lessening the amount of urine, rendering it highly colored, and in some instances producing **albuminuria, hæmaturia,** and even total suppression. This irritant action extends to the whole genito-urinary tract. There is much aching in the loins, with spasmodic pain in the ureters, a sensation of heat in the perineum, and a general condition of **strangury.** Priapism may be induced, and an intolerable irritation may affect all the pelvic organs. In especially susceptible individuals symptoms of this character may be caused by even moderate amounts of the drug. A characteristic effect of turpentine is the odor of violets which it imparts to the urine.

Skin.—There is reason to believe that it is excreted to some extent by the glands of the skin. In persons with an idiosyncrasy to oil of turpentine, erythematous, papular or vesicular eruptions may be caused by both its external and external use.

Temperature.—It appears to have a slight antipyretic action.

It seems probable that it is excreted in part by the intestine and in the bile, milk, and other secretions.

Old oil of turpentine, containing oxygen, is an antidote to phosphorus (*see* p. 793). The statement has been made that this and the French oil are preferable in other respects; but this seems questionable.

Therapeutics of Oil of Turpentine

External.—It is highly esteemed as a **counter-irritant** in bronchitis, pneumonia, pleurisy, peritonitis, osteo-arthritis, and other inflammatory conditions, and in such painful disorders as pleurodynia, neuralgia, myalgia and lumbago. It is often employed in the form of a stupe, which consists of flannel, wrung out of hot water, on the surface of which a few drops of turpentine are sprinkled just before application. Turpentine stupes should be removed as soon as they cause pain. When friction is desired, as for instance in rheumatic joints, it is advisable to use turpentine in the form of the official liniment which, for most purposes, should be diluted. Oil of turpentine has been used with success in the treatment of severe burns, accompanied by constitutional depression, and it is an excellent antiseptic for old suppurating wounds but care must be taken that it does not blister the skin.

Internal. *Stomach and Intestines.*—For internal use the rectified oil only should be prescribed. It is not very frequently employed as a stomachic, but is used to a considerable extent as an intestinal **carminative**; and flatulence may often be promptly relieved by a few drops on sugar. It is regarded as especially indicated in persistent flatulence resulting from a paretic condition of the muscular coat, and among the indications for its administration may be mentioned a dry and glazed tongue, tympanitic distention of the abdomen, and stools which are either fluid or consist of scybala mixed with mucus and pale, watery blood. From our knowledge of the physiological effects of oil of turpentine it would be supposed that it might prove of service in typhoid fever, both as a hæmostatic and an antiseptic, and in many instances of this disease it is found to be of the greatest practical value since it not only acts only as a local stimulant to the ulcerated bowel, but also exerts a beneficial influence upon the general state of the system. Two conditions have been pointed out in which it is especially useful. This first is when at about the end of the second week the tongue becomes very dry, red, fissured, and perhaps coated in the center with a brownish fur, and

at the same time marked **meteorism** develops. Here, rectified oil of turpentine, 0.60 mil (ɪo ♏) given every two or three hours will be found in many instances to do away with these unfavorable signs. The second is when the ulceration of Peyer's patches proves slow to heal, so that there is a constant tendency to the recurrence of diarrhœa, and convalescence is thus delayed. Here the remedy seems to act almost as a specific. It is stated that the typhoid fever bacillus will not develop in air containing diluted vapor of turpentine, and dies when the air is saturated with the vapor. The intestinal hæmorrhage of typhoid may also often be successfully treated with oil of turpentine. Administered in the form of an enema, in such a vehicle as mucilage of starch, it is very effective in relieving flatulence of the bowels, and where there is impaction of the cæcum or rectum, castor oil is frequently combined with it in the injection. Turpentine has also been used by enema as a derivative in insolation or sunstroke and in cerebro-spinal meningitis, as well as a remedy for thread-worms. A combination of equal parts of oil of turpentine and ether (Durand's remedy) at one time acquired considerable reputation in the treatment of biliary calculi when administered during the intervals of attacks of colic.

Circulation.—It is contra-indicated where there is active hæmorrhage and a condition of plethora, in hypertrophy of the heart, and when advanced atheroma of the cerebral arteries is believed to be present. In the passive hæmorrhages in adynamic diseases, where there is a condition of debility, relaxation of the vessels, and an impoverished condition of the blood, it is of great service. It may be given in hæmorrhages from the stomach, bowels, lungs, etc., and is also efficacious in the hæmorrhagic transudations met with in purpura, scurvy, and allied states.

Respiration.—It is occasionally used internally in chronic bronchitis with profuse expectoration, especially when the latter has a fetid odor, and in gangrene of the lung. It may also be employed in pneumonia and capillary bronchitis with marked depression of the vital powers and enfeeblement of the circulation, and particularly when these affections occur in the course of typhus or typhoid fever and similar diseases.

Genito-urinary Tract.—Oil of turpentine would no doubt be more generally employed than it is in a variety of affections, as it unquestionably has considerable useful application, were it not so

liable to cause inflammation of the kidneys. On this account it must always be administered with caution, and it is, of course, entirely contra-indicated when renal disease is present. An exception as regards the latter, however, should sometimes be made in chronic pyelitis, where the oil of turpentine may have a good effect in limiting the formation of pus; also in hydro- and pyo-nephrosis, where by actual contact it may alter the relaxed state of the vessels and the pathological secretions of the mucous membrane. In these conditions it should always be given in small doses and its effects watched with extreme care. In incontinence of urine, due to atony of the muscular coat of the bladder and not to spasm, and in chronic cystitis, gleet, spermatorrhœa and prostatorrhœa, when the discharges characterizing these affections are the result of relaxed conditions, in moderate doses it may not infrequently be administered with considerable benefit.

OIL OF DWARF PINE NEEDLES

For the Preparation of Oil of Dwarf Pine Needles *see* p. 219.

Action and Therapeutics of Oil of Dwarf Pine Needles

This oil has practically the same action as oil of turpentine. It contains but little pinene, and is not irritant when applied to mucous membranes. On account of its more **agreeable** odor it is preferred to oil of turpentine for stimulating and disinfectant inhalations and sprays designed for use in various affections of the upper air passages. The strength employed for inhalation is: Oil of Dwarf Pine, 2; Light Magnesia, 1; water to 24. Four mils (1 fl. dr.) may be used in 500 mils (1 pt.) of hot water. For a spray it may be diluted with liquid petrolatum to make a 4 or 5 per cent. solution.

TAR

For the Preparations of Tar *see* p. 218.

Action of Tar

External.—Though its effects are somewhat less pronounced, tar is, like oil of turpentine, a **local irritant**, by reason of its action in dilat-

ing the blood-vessels. If its application is prolonged, it is likely to induce an eruption of red papules, some of which may suppurate, constituting what is known as "tar acne." This is sometimes met with in those who work in tar or are much exposed to its fumes. When it is applied over a large area, absorption from the skin may give rise to toxic symptoms resembling those of phenol poisoning. In less concentrated form it relieves itching, an effect which has been attributed to its reducing the sensibility of the sensory nerve terminations. The vapor, when inhaled, has a local **antiseptic** and **stimulant** action on the **respiratory mucous membrane.** Tar has very valuable antiseptic and **disinfectant** properties, and on account of its cheapness it is especially serviceable for the disinfection of excrement, etc.

Internal.—In small doses it has the effect of stimulating the circulation and increasing the secretions. It is excreted by the kidneys and the respiratory mucous membrane, and acts as a stimulant and antiseptic during elimination. It is thus both a **diuretic** and **expectorant.** In large doses it produces headache, epigastric and abdominal pain, general malaise, indigestion, vomiting of dark-colored matter, loose black stools, and blackish-brown urine, which smells of tar and may contain blood or albumin. The urine may possibly be clear when passed, but on standing it throws down a dark deposit.

THERAPEUTICS OF TAR

External.—The chief use of tar is for the local treatment of certain forms of skin disease, and for this purpose it is applied in lotions, paints, ointments, plasters, soaps and baths. The official ointment is liable to cause more or less irritation, and should generally be diluted. Tar is especially useful in **scaly affections,** such as psoriasis. Among the skin diseases in which it is serviceable may be mentioned lichen, chronic eczema, sycosis, pemphigus, prurigo, and lupus erythematosus and vulgaris, as well as scabies and ringworm. In some individuals there is an intolerance of tar, so that even the smallest quantity will be found to excite irritation and cause a papular or eczematous eruption.

Internal.—Tar is used internally almost exclusively as an **expectorant,** in bronchial affections, and it is in the chronic forms of these that it proves especially valuable. Sufferers from chronic

bronchitis sometimes derive considerable benefit from the fumes given off from tar, which is heated in a vessel, in the room occupied by them. An excellent cough mixture consists of the syrups of tar and wild cherry, with 0.003 gm. (1/20 gr.) of apomorphine hydrochloride in each dose. In chronic diseases of the skin the internal administration of tar is sometimes a valuable adjunct to local treatment, and has been found especially favorable in psoriasis and eczema. Tar has also occasionally been given internally in catarrh of the urinary tract.

OIL OF CADE

For the Preparations of Oil of Cade *see* p. 218.

Action and Therapeutics of Oil of Cade

Oil of cade has much the same action on the skin as tar, but its preparations have decidedly less odor and are less injurious to the clothing.

It is too stimulating for acute eruptions, but is used with benefit in chronic eczema, psoriasis, pityriasis rubra, lichen, prurigo, and various forms of pruritus. It is also an efficient **parasiticide** in favus and other varieties of tinea. It is sometimes applied in full strength and sometimes diluted with a bland oil, and is also made into ointments, and especially into soap, as oil of cade, 1; soft soap, 4; alcohol, 4. An ointment made by melting with it an equal part of yellow wax is a stronger and more agreeable preparation.

ROSIN

For the Preparations of Rosin *see* p. 217.

Action and Therapeutics of Rosin

Rosin, locally, is antiseptic and slightly irritating; internally it is **antiseptic** and **astringent** in its effects upon the intestines. It has the property of preventing the oxidization of fatty substances, and thus contributes to the preservation of ointments.

Rosin cerate is a good dressing for indolent ulcers and wounds, **promoting cicatrization** and granulation, as well as acting as a disinfectant. It is also sometimes applied to burns and chilblains.

The chief use of rosin is in plasters, which it renders adhesive and more or less stimulating.

MUSTARD

For the Preparations of Mustard *see* **p. 219.**

Action of Mustard

External.—Oil of mustard differs from the other volatile oils in that it produces a greater irritation. Being extremely diffusible, it has a very **deep action,** without producing very profound destruction of the surface. Locally applied, mustard is a **rubefacient, counter-irritant,** and nervous stimulant, causing heat, redness, and severe burning pain. These effects are produced by its action in dilating the blood-vessels and irritating the sensory nerves. The **stimulation** of the latter is **followed** by their **paralysis,** in consequence of which there results a local **loss of sensibility.** If the application is sufficiently prolonged, it induces **vesication,** the irritation of the vessels leading to the transudation of serum, which raises the epidermis and thus forms vesicles or blisters. The blistering caused by it is more painful and heals less rapidly than that of cantharides, which is no doubt due to the fact that the oil of mustard penetrates more deeply into the tissues and thus sets up more extensive inflammation. When the drug itself, moistened, is applied to the skin, the oil is found to form only slowly, so that the action of the irritant becomes continuously more intense. The excitation of the sensory nerves caused by the external application of mustard is sufficiently powerful to induce more or less reflex stimulation of the heart and respiration, and sometimes to restore consciousness to those suffering from syncope.

Internal. *Gastro-intestinal Tract.*—Mustard is also a powerful **irritant** to the alimentary canal. In small amounts it is taken as a condiment and stimulates the appetite. Large doses irritate the stomach and produce prompt vomiting, which, in consequence of the **reflex stimulation** of the **heart** and **respiration** caused by the drug, is not attended with the depression usually resulting from emetics. The emetic effect is increased by giving the mustard in a considerable quantity of lukewarm water. The oil of mustard is an energetic irritant, a single drop upon the tongue producing an intense burning pain in the nose, throat and stomach.

General Action.—Upon the organs and tissues mustard, in ordinary doses, has very little appreciable effect, but very large doses of the oil may prove fatal to animals. The action of the heart is at first increased and then diminished, the respiration becomes impeded, insensibility follows, and a fall of surface temperature precedes death. Post-mortem there is found redness, but only slight inflammation, of the gastro-intestinal tract, with destruction of the epithelium. The kidneys are also hyperæmic, and the blood may smell of mustard.

Therapeutics of Mustard

External.—A mustard plaster or sinapism is a very useful means of relieving gastralgia, neuralgia, pain in chest affections, lumbago, and a variety of other conditions. While the application itself may be temporarily painful, the secondary effect, both as to the pain due to the mustard and that from the condition present, is soothing, in consequence of the **loss of sensibility** resulting from the paralysis of the sensory nerves produced by the drug. Sinapisms are best applied a little distance from the seat of pain. Thus, to relieve headache they are most serviceable when placed at the nape of the neck. They are also applied to the epigastrium in persistent vomiting, to the loins in suppression of urine, to the præcordial region in threatened syncope, and to the calves of the legs and other parts of the body in narcotic poisoning, asphyxia or syncope. In the latter conditions the object is, of course, to **stimulate the nervous system,** but in all instances of insensibility care should be taken that the application is not continued too long, on account of the danger of causing vesication or even more serious local trouble. In their use for children the proportion of mustard employed should not exceed one-fourth. The mustard leaves and papers sold in the shops are very convenient for ready use. They are generally very strong, however, and one or two layers of moistened linen should be placed between the sinapism and the skin to prevent too violent an action. One advantage which mustard possesses for the purpose of revulsion is the readiness with which its action may be controlled by the regulation of the strength of the application and the time which it is allowed to remain. In many instances it is desirable to maintain for hours a mild equable counter-irritant impression, and this may be done by adding about

one-sixteenth part of mustard to a flaxseed poultice. In bronchitis, pleurisy or pneumonia a "jacket poultice" is often applied to the chest, and the larger the poultice the more pronounced is the effect upon the internal organs. Large mustard poultices are also used with advantage in acute inflammations of the abdominal viscera. When it is desired to dilate the peripheral vessels over a large area, in order to withdraw blood from internal parts and thus produce a "derivative effect," a warm bath to which mustard is added (1 to 128) is often serviceable. A general mustard bath is chiefly employed for children in the early stages of febrile diseases or bronchitis. In older persons a hot mustard foot-bath, which ought to reach nearly to the knees, is useful for the relief of incipient colds and various febrile conditions. A hot mustard sitz-bath or foot-bath is commonly employed, just before the expected period, to induce menstruation, as well as to relieve the congestive headches, flushings, and nervous symptoms often met with at the time of the menopause. When a hot bath is prescribed in which mustard is the active agent, the temperature of the water is not so much considered as the feeling of warmth engendered by the drug. It will be remembered that mustard is more active in warm, not hot, water.

Internal.—A tumblerful of lukewarm water, with the addition of 4 to 16 gm. (1 to 4 teaspoonfuls) of mustard is in general use as an **emetic,** and is especially advantageous in instances of narcotic poisoning by reason of the reflex stimulation caused by the mustard. Otherwise the drug is not very often employed internally, except as a condiment, although it may occasionally prove of service.

OIL OF CAJUPUT

For the Preparations of Oil of Cajuput *see* p. 220.

Action and Therapeutics of Oil of Cajuput

Externally, oil of cajuput is rubefacient and irritant, and upon the subsidence of the hyperæmia it is an anæsthetic. Internally, it is a mild antiseptic and carminative.

External.—Being a strong, stimulating **rubefacient** and **irritant,** it is rubbed into the skin—usually diluted with olive oil—in a variety of conditions such as muscular pains, nervous headaches, and

chronic inflammatory affections of the joints as well as in such cutaneous diseases as chronic eczema, psoriasis and rosacea. In alopecia it is used as an ingredient of various stimulating ointments. On account of its parasiticidal properties it is also of service in the treatment of tinea, scabies, etc.

Internal.—Being a stimulant **carminative,** it is useful in flatulence accompanied by pain and other varieties of digestive disturbances, and it is also of service in spasmodic affections of the stomach and bowels. It is reputed to be beneficial in chronic rheumatism, and in catarrh of the bladder, as well as in elephantiasis and certain skin diseases. It has also been administered as a vermifuge, and prescribed, in the form of an emulsion, as an injection for thread-worms.

Since the terpenes contained in the oil are less irritant than those found in similar volatile oils there has been of late a more extensive use of the oil of cajuput in the treatment of laryngitis, bronchitis and pulmonary tuberculosis.

EUCALYPTUS

For the Preparations of Eucalyptus *see* p. 221.

Action of Eucalyptus

External.—Oil of eucalyptus is a very active **disinfectant.** As regards the antiseptic properties of the oil, ozone is regarded as by far its most valuable constituent, and next to this come the pinenes and other terpenes, which are not only antiseptic in themselves, but are the agents in the production of the ozone. The oil is a **rubefacient,** but less irritant to the skin than oil of turpentine and some other volatile oils. If evaporation is prevented, however, it will produce vesication, and even pustulation.

Internal. *Gastro-intestinal Tract.*—Ordinarily it produces very much the same effects as oil of turpentine in small doses, but large amounts of it are capable of exciting indigestion with eructations, and nausea, vomiting and diarrhœa, with severe abdominal pain.

Circulation.—In doses such as promote appetite and digestion it increases the heart's action and causes a rise of blood-pressure; effects which are no doubt due to the reflex stimulation from the stomach. Large doses depress the heart and cause a fall of blood-

pressure, at the same time producing great muscular weakness and lowered temperature. The leucocytes of the blood are restricted in their movements, diapedesis is prevented, and pus formation diminished. The surface of the red corpuscles has been observed to appear crenated, and the nucleus, when present, more distinct.

Respiration.—While small doses slightly accelerate the respiration, large doses depress it, and in toxic amounts it causes paralysis of this function by direct action on the respiratory center in the medulla.

Nervous System.—Small doses have the effect of stimulating mental activity. The stimulation of the central nervous system is, however, only very transient, and is followed by marked depression. Under toxic doses the brain, medulla and spinal cord are all affected, the reflexes are abolished, and loss of sensation in the lower limbs may occur.

Spleen.—It has been thought to be more or less antiperiodic, but that it has any specific action of this kind is denied on the ground that it has the same constituents as several other oils which seem to have no such properties.

Absorption and Excretion.—It is absorbed from the skin, respiratory mucous membrane, and alimentary canal, and is excreted by the skin, the respiratory and other mucous membranes, and by the kidneys. It therefore has more or less action as a diaphoretic, expectorant, diuretic and stimulant to the genito-urinary tract.

Therapeutics of Eucalyptus

External.—It is used as an antiseptic in surgery. As a lotion or dressing for wounds, sores, etc., and especially for chronic, or indolent ulcers, a weak solution of the oil in alcohol, may be employed. The oil has been employed as a mild counter-irritant in affections of the chest and of the joints, and its local stimulant effects sometimes prove valuable in the treatment of anhidrosis and of alopecia. A 10 per cent. solution of eucalyptol in pure alcohol has been used as a local antiseptic application in diphtheria, and the oil in a vaporized state has been employed for inhalations in this disease. Similar inhalations may likewise be given for dilated bronchi, bronchitis with fetid expectoration, gangrene of the lungs, ozæna, etc. In asthma, eucalyptus leaves are sometimes smoked in cigarettes made with

stramonium leaves, but how much of the benefit derived from their use is attributable to the eucalyptus seems rather uncertain. A decoction of the leaves may be used as an injection for thread-worms. In cancer of the rectum or uterus the topical application of eucalyptol frequently diminishes the amount and fetor of the discharges.

Internal.—Eucalyptus is useful as a stomachic and carminative, provided no inflammatory action is present, in atonic dyspepsia, and in chronic gastric and intestinal catarrh, and it is especially efficient in the form of vomiting and indigestion caused by sarcinæ. In convalescence from acute disease and in cachectic conditions generally, it strengthens the action of the heart and often constitutes a satisfactory stimulant. Hysteria, neurasthenia, chorea, and similar conditions, as well as cerebral anæmia, may be benefited by eucalyptus, and it is likely to be of service in the nervous phenomena which characterize the climacteric period. The remedy is especially valuable in subacute and chronic **catarrhal affections of the bronchial mucous** membrane and that of the genito-urinary organs, by both of which it is excreted. There seems to be no question of its value in the declining stage of pneumonia, in pulmonary gangrene, in chronic bronchitis, and particularly in bronchorrhœa and fetid bronchitis. Among the genito-urinary affections in which it has been found of service may be mentioned chronic desquamative nephritis, granular degeneration of the kidneys, pyelonephritis, hydronephrosis, gleet, and particularly chronic catarrh of the bladder, when administered with caution, and not too continuously, on account of the danger of exciting renal congestion.

It appears to have a certain amount of usefulness as a remedy for malarial conditions, and some clinicians have found it very serviceable in the convalescence from intermittent and remittent fevers and in chronic malarial poisoning. It has sometimes, but rarely, proved curative in instances where quinine had failed.

TOXICOLOGY

In fatal poisoning by oil of eucalyptus, death is preceded by great embarrassment of respiration. *Post-mortem.*—In one instance reported, there was found a large quantity of blood in the pleural cavities, the lungs were collapsed and bloodless, and the right heart contained frothy blood.

Treatment.—Cardiac and especially respiratory stimulants should be used promptly.

OIL OF ROSEMARY

For the Preparations of Oil of Rosemary *see* p. 222.

Action and Therapeutics of Oil of Rosemary

The action of oil of rosemary is like that of other similar volatile oils. It is said, especially when inhaled, to reduce the body-heat and impart to the urine a violaceous odor.

Externally, rosemary is employed chiefly as a **stimulant** in lotions, liniments and ointments. In facial acne it is thought to have a special beneficial action, and, on account of its **parasiticidal** property, it is efficacious in applications for scabies and the different varieties of pediculosis. Internally it is occasionally given as a carminative in flatulence and colic and as a stimulant in hysteria accompanied by depressed spirits.

ARNICA

For the Preparations of Arnica *see* p. 222.

Action of Arnica

On account of its volatile oil, arnica has the same action as the volatile oils in general. In large doses it is a gastro-intestinal irritant, causing vomiting and purging, and also produces headache, unconsciousness, fall of temperature, paralysis of the nervous system, both motor and sensory, and sometimes collapse and death; in some instances convulsions occur. In moderate doses it slows the pulse, raises the blood-pressure slightly, and stimulates the vagus nerves, while toxic amounts produce a rapid pulse from paralysis of these nerves. It is excreted mainly by the kidneys and mucous membranes.

Therapeutics of Arnica

External.—The diluted tincture is used for myalgia, sprains, bruises and external inflammations generally, but should not be applied if the skin is broken, and should always be used with caution if the integument is sensitive. Some, especially gouty, individuals, appear to have an idiosyncrasy in respect to arnica, and in such there may be caused by it violent cutaneous inflammation, with the production of pustules attended with severe constitutional symptoms.

Internal.—Except as a stomachic, carminative and reflex stimulant when given in small doses, many consider arnica, internally, as too unreliable to be of much therapeutic value. Others, however, assert that it is a remedy of distinct usefulness in a variety of conditions. Thus, it is claimed that ecchymoses are rapidly dispersed by its internal, as well as its external administration, and that for internal contusions from shock or concussion its use by the mouth has proved very efficacious. Furthermore, that it has rendered good service in delirium tremens, epistaxis, hæmoptysis and other hæmorrhages, paralysis of the bladder, and chronic dysentery.

CANTHARIDES

For the Preparations of Cantharides *see* p. 258.

Action of Cantharides

External.—Cantharides is a **powerful irritant,** but its mode of action remains unexplained. It acts **more slowly** than **most irritants,** so that if applied to the skin, it will usually be two hours before any appreciable effect is produced. The first symptom from it is a tingling, burning pain in the part, which very shortly becomes reddened in consequence of the local vascular dilatation caused. In the course of four hours after the application numerous vesicles make their appearance, and these soon coalesce, forming large blebs, varying in area according to the extent of the application, which are filled with clear serum. Although the local action is **violent,** it is very **superficial.** Hence, as less of the irritant penetrates into the deeper tissues and the process is much slower, the **vesication** is much **less painful** than that caused by mustard. If the blister be broken, however, and the irritant be allowed to come in contact with the unprotected skin, severe inflammation, with much pain, suppuration and even sloughing, is liable to result. Cantharides is an energetic **counter-irritant,** as well as a **rubefacient** and **vesicant,** and this action is porbably due to an alteration in the caliber of the blood-vessels and in the sensory nerves, or their terminations, reflexly induced by it, in the deep-seated organs in the vicinity of the part to which it is applied.

Internal. *Gastro-intestinal Tract.*—When taken in sufficient quantity by the mouth, cantharides produces the same **irritant** effect

along the alimentary canal, and gastro-enteritis results. If swallowed in solution, blisters are formed in the mouth and throat, and deglutition is rendered difficult or impossible by the excruciating pain and the swelling in the œsophagus caused by it. There is also intense pain in the abdomen, and vomiting ensues, followed by purging, with all the symptoms of shock and collapse. Both the matters vomited and the stools may contain blood. Ulceration of the stomach and other portions of the alimentary canal have been observed after death, not only when cantharides has been administered by the mouth, but also when the drug has been given by subcutaneous injection, and it is thought possible that it is excreted in part by the stomach.

Genito-urinary Tract.—The effect upon the kidneys is seen in **diuresis,** and when a larger amount is absorbed, in nephritis, albuminuria, hæmaturia, glycosuria, and sometimes in total suppression of urine. The bladder and urethra also show the action of the irritant, and **strangury,** with a constant desire for micturition, priapism, etc., is reflexly induced. The vesical tenesmus is extreme, and the patient suffers from severe pain in the loins. The local irritation is apt to occasion erotic excitement, with seminal emissions in the male, and there may also be swelling and inflammation of the external genitals. Sufficient of the active principle may be absorbed from a cantharides blister to cause marked renal irritation and strangury. The drug is chiefly excreted by the kidney, and the nephritis is the important factor in death from cantharidal poisoning.

Therapeutics of Cantharides

External.—Cantharides is, of all drugs, the most commonly used as a **vesicant** and **counter-irritant.** Blisters may be made with cerate of cantharides spread upon linen. The raised cuticle should not be removed, but simply punctured to allow the escape of the serum, and the surface should then be dressed with some bland fat. A convenient method is to paint the desired area with two coats of cantharidal collodion, and then lay over it a piece of waxed paper. The tendency to strangury is diminished by the free use of diluent drinks. Blisters are employed to **relieve pain,** reduce inflammation, and promote the removal of inflammatory products by absorption. They are thus of service in a great variety of conditions, applied

over the chest in pleuritic effusions, a succession of small blisters being most efficacious, behind the ear in aural inflammations, on the perineum in obstinate gleet, around the affected joints in acute rheumatism, at the nape of the neck in severe headaches, and over the epigastrium for persistent pain in the stomach, vomiting, etc. They are of great value in neuralgia, especially if applied close to the emergence of the nerve from the spinal column, and also in sciatica and neuritis and in subacute joint affections. The moral impression produced by the use of vesication is not infrequently beneficial. Hysterical paralysis is most successfully treated by encircling the affected extremity with narrow blisters, and hysterical aphonia may sometimes be quickly cured by a blister over the larynx. In blistering with cantharidal preparations the plaster should be removed as soon as the bleb has formed, on account of the danger of the absorption of cantharidin. When strangury is produced, relief may be afforded by an enema of laudanum. Among the conditions contra-indicating the use of blisters may be mentioned the acute stage of an inflammation, scurvy and purpura, pregnancy, infancy, and debility. They should never be applied to a part on which a patient lies, on account of the risk of the formation of bed-sores, or to paralyzed limbs, and are contra-indicated in renal disease or inflammation of the urinary passages.

Cantharides is one of the most common and useful remedies employed in the treatment of alopecia, but it is hardly likely to prove of service if the treatment is begun late. It is usually applied in the form of the tincture, largely diluted with alcohol. In alopecia circumscripta the collodion painted over the bald patches every week or ten days, is often successful.

Internal.—It is occasionally given in the form of the tincture, in small doses, principally as **a stimulant** to the urinary organs, and among the conditions in which it has been commended are hæmaturia, incontinence of urine, chronic pyelitis, chronic cystitis, irritability of the bladder, gleet, prostatitis, and spermatorrhœa due to deficient tone of the seminal vesicles. It is naturally contra-indicated when any active inflammation is present. It is most relied upon in the treatment of impotence, in which condition it may prove of service through reflex irritation from the urethral mucous membrane, but its administration is attended with considerable danger, however, since efficient doses are apt to induce nephritis.

TOXICOLOGY

Symptoms.—In patients when lethal amounts have been taken, there usually results dyspnœa, great frequency of the pulse, and finally collapse and coma, death being sometimes preceded by convulsions. These fatal effects would appear to be dependent upon suppression of the urinary functions in consequence of the violent nephritis caused by the drug. It is one of the substances employed for the purpose of producing abortion with criminal intent, and it is in instances of this kind that symptoms of poisoning are most likely to be observed.

Post-mortem.—There are found swelling and intense hyperæmia of the gastro-intestinal mucous membrane, with ecchymoses and often ulceration; and the appearances of acute inflammatory action in the kidneys, bladder and entire genito-urinary tract.

Treatment.—There is no chemical nor physiological antidote. The stomach should be emptied by emetics (*see* p. 380), or washed out by the stomach-pump. Mucilaginous and demulcent liquids should be freely given. Opium is indicated to relieve the pain and gastro-enteritis.

(*b*) Acting generally.

AMYL NITRITE

For the Preparation of Amyl Nitrite *see* p. 103.

Action of Amyl Nitrite

External.—Amyl nitrite has no irritating qualities, but it causes loss of functional power in tissues with which it is brought into contact, therefore, it temporarily diminishes the activity of the sensory nerves.

Internal.—When it is inhaled, the usual mode of administration, its characteristic effects are produced with extraordinary rapidity, but if the dose is small, they are evanescent.

Circulation.—Immediately on its inhalation there follow marked **flushing** of the face, pain, heat and a sense of fullness in the head, giddiness, throbbing of the temporal and carotid arteries, and a **rapid** and **tumultuous** action of the **heart.** Sometimes, the cardiac disturbance is distinctly manifest before the other symptoms. While the area of redness usually corresponds with that involved in blushing, it may extend over the entire trunk, and the flushing is due to the **dilatation of the peripheral blood-vessels,** which may spread over the entire body, although the vessels of the extremities are involved to a less extent than those of the splanchnic region. It seems probable that depression of the vaso-constrictor center is concerned to

some extent in the general vascular dilatation, but this is certainly not the main cause, since it has been shown that amyl nitrite produces dilatation by acting on peripheral structures. The place of action of the drug is held to be the unstriated muscle of the arteries and veins, and the depression of the function of this tissue and of the nerve terminations is now generally considered as the essential cause of the dilatation. That there is, however, an early central action, which later is overshadowed by this peripheral influence, it is thought may perhaps be indicated by the rapidity with which the flushing of the face comes on and disappears. In consequence of the acceleration of the heart, there may at first perhaps be even a rise of blood-pressure, the dilatation being more than overcome by the quickened beat; but as the dilatation extends throughout the body, the relaxation, particularly in the splanchnic area, soon has the effect of producing a profound fall in the blood-pressure. It also causes a dicrotic pulse. The tachycardia is generally attributed to a depression of the inhibitory (vagus) center in the medulla, though vasomotor paralysis would also produce a rapid pulse and it is thought that there is present, in addition, a feeble direct action on the heart. Large doses of amyl nitrite slow and weaken the cardiac contractions and finally arrest them, owing to direct muscular depression; but this direct action on the heart muscle, it is found, is produced much less readily than that on arterial muscle. While the drug has such a marked influence on accelerating the beat, no perceptible alteration in the force of the latter is caused by it.

Respiration.—The quickness of the action of amyl nitrite is due to the extraordinary rapidity with which it is absorbed, especially through the lungs, and its first effects resemble very closely an incipient asphyxia. Under the stimulating effect of the drug upon the respiratory centre in the medulla the respiration is quickened and deepened, but if the inhalation is maintained sufficiently long, this effect is replaced by a depressing one, and, in consequence, the respiratory movements are rendered more slow and shallow; death eventually occurring from **asphyxia** due to a complete paralysis of the center.

Blood.—The immediate cause of the asphyxia is the production of **methæmoglobin,** a compound which parts with its oxygen much less readily than oxyhæmoglobin, but which is eventually broken up by the tissues. The nitrites, however, unlike most other agents which

change hæmoglobin into methæmoglobin, do not have the power of causing destruction of the red corpuscles.

Kidneys.—It is excreted by the kidneys, chiefly as a nitrate. The only effect of the drug on the urinary secretion appears to be dependent upon its action on the circulatory system. If, therefore, the renal arterioles are relatively more dilated than those of the general circulation, the flow of urine will be increased, while if the reverse of this condition is present, it will be diminished. Its diuretic influence is never very marked, and if large amounts are taken, so that the blood-pressure is reduced to a low point, complete anuria may result. Sometimes in animals there is persistent glycosuria, and it is thought that this may perhaps be due to the partial asphyxiation of the tissues resulting from the formation of methæmoglobin.

Nervous System.—Amyl nitrite is not known to exert any influence on the higher cerebral centers, excepting that the vagus center may be depressed while the respiratory center is somewhat stimulated. While action upon the vaso-motor center has not been demonstrated, it seems probable that the drug does possess such; which, however, must be quite insignificant when compared with its effects on the peripheral vaso-constrictor mechanism. It acts not only upon the muscular coats of the vessels, but also produces paralysis of muscles of all kinds with which it comes in contact. The pain and sense of fullness in the head, as well as the giddiness and other symptoms following immediately upon inhalation, result from the vascular dilatation, in which the cerebral circulation fully participates, and the headache may persist for a considerable time, or even be so violent that the remedy must be stopped. If large quantities are inhaled, there may be unsteadiness of gait and some confusion and restlessness.

Eyes.—There is often a dimness of vision, possibly due to dilated retinal arteries. The pupils are dilated and dark objects may appear to be surrounded with colored rings.

Muscles.—The arterial muscles are most affected, next the bronchial, and there may be some relaxation of spasm in the common bile duct or ureter, should such conditions exist.

Therapeutics of Amyl Nitrite

External.—Theoretically, it might be employed to relieve pruritus but in practice, too much of the drug would be inhaled and disagreeable symptoms be produced.

Internal. *Heart and Blood-vessels.*—In attacks of **angina pectoris** it is of great service, provided the arterial tension is high. When the rise of blood-pressure is due to a nervous contraction of the vessels, it is certain to give relief. In many instances where valvular disease of the heart is present, as well as in those in which there is merely functional disorder, it acts most promptly and efficiently. The benefit from amyl nitrite in the dyspnœa of patients suffering from cardiac disease may, it is thought, be due to its lowering the pressure in the systemic arteries and thus relieving the heart. Its beneficial effects would not therefore result from any direct action on the heart, but from its decreasing the resistance against which the systole is performed. Its physiological action is accelerating the pulse-rate has led to its recommendation in all forms of sudden heart-failure, eve when such failure is dependent upon fatty degeneration or other disease of the heart itself. It may be stated, however, that in very advanced degeneration of the cardiac muscle fiber it is distinctly contra-indicated, since, the blood-pressure already being low, any further reduction may induce syncope from cerebral anæmia, while the heart may be still further weakened by the lessening of its nutrition from lowered pressure in the coronary arteries. It is also unsafe when advanced degeneration of the cerebral vessels exists. It may be employed in all instances in which, there being no contra-indication to its use present, it is desired to reduce the arterial tension. In practice is it found that dyspnœic attacks connected with heart failure from valvular disease and other causes are not infrequently relieved by it.

A small amount of the vapor may no doubt be of service in certain instances of syncope and cardiac failure where deep inhalations might perhaps be a source of danger. In heart-failure from fright, for instance, it has often proved of great value in a single inspiration, but if it does not afford relief at once it is useless to continue it.

Aside from cardiac affections, it is especially indicated in various morbid conditions resulting from vaso-motor spasm, and should be employed whenever dilatation of the capillaries is likely to prove of service. For relaxing general spasm and spasm of the muscular fibers of either the voluntary or involuntary muscles it is a highly esteemed remedy. In tetanus and in strychnine poisoning it may prove of distinct value. It should be used between the spasms or else administered by subcutaneous injection, as the re-

spiratory cramp interferes with its absorption by inhalation. Good results have been reported from its employment in *trismus nascentium*. In persistent hiccough the inhalation of amyl nitrite has been known to arrest the spasm of the diaphragm after other measures had failed.

There can be no question of its utility in many instances of epilepsy in which the paroxysm is preceded by an aura, giving the patient warning of its onset. By relieving the vaso-motor spasm of the cerebral vessels it often serves to prevent the occurrence of the fit if inhaled in time, and consequently epileptics who have such a warning of impending seizures should be provided with a supply, which can be most conveniently used when put up in small glass capsules known as "pearls," each containing 0.30 gm. (5 ♏), which can be readily crushed in the handkerchief. After the paroxysm has commenced the remedy is hardly likely to be of much service, except in those instances which are apparently dependent on a vaso-motor spasm of the vessels supplying the motor areas, and if resorted to should be employed with caution, because its early effects will be obscured by the patient's condition. In what is known as the *status epilepticus*, however, where there is a series of recurring paroxysms, it has sometimes been found of great service in checking the convulsions. One of the uses of amyl nitrite is as a means of diagnosis between true *petit mal* and instances in which that affection is simulated by attacks caused by temporary congestion of the nerve-centers. In the latter the nitrite, instead of alleviating the condition, intensifies the paroxysm. In any convulsive disorder in which the condition is regarded as attributable to a vaso-motor spasm of the vessels supplying the motor areas it would naturally be likely to prove beneficial. In many instances of hysterical convulsions, whatever may be the primary cause of the nervous trouble, such a state of vaso-motor spasm undoubtedly exists, if only a link in the pathological chain, and in practice it has not infrequently been found to arrest the paroxysms, while not controlling other symptoms. Amyl nitrite is antagonistic to ergot in its action. It may therefore be given to counteract the untoward effects of this drug, and its inhalation has been known to promptly reduce hour-glass contraction of the uterus caused by the latter.

It may often be used with advantage in various painful affections in which there is a spasmodic element, and among these may be mentioned spasmodic dysmenorrhœa and angiospastic hemicrania.

In those forms of migraine in which there is local vaso-motor spasm, causing contraction of the capillaries, it is a most valuable remedy; but if, instead of a pallid there is a flushed countenance, with conjunctival injection, it will only aggravate the patient's suffering. As to headache in general, it will sometimes relieve and at others increase the pain, its effect depending on whether the arterioles are constricted or dilated. Neuralgia of the fifth nerve and other neuralgias are at times relieved and in some instances cured by it. If the pain returns, the inhalations should be repeated as required. In *tinnitus aurium*, which is also often very obstinate, decided benefit in a considerable proportion of instances has been derived from its use.

In its action of relieving spasm of the muscular system generally, as well as of the arterioles, are included the bronchial tubes, and hence it has been found a valuable remedy for the symptom asthma. In the paroxysms of typical asthma it usually, though not always, affords immediate and complete relief, from its direct action on the bronchial muscles. At the same time it will stimulate the respiratory centers so that the breathing will become deeper and more rapid. The temporary stopping of respiration on inhalation, results from irritation of the upper respiratory tract and almost immediately ceases. What interferes with its usefulness, however, is the fact that the patient rapidly becomes accustomed to its employment, and hence increasing doses are necessary when it has to be administered frequently. There can be little question of its beneficial effect in many, though by no means all, forms of seasickness. In intermittent fever it will abort the cold stage of the paroxysm, but has no influence upon the ensuing hot stage. It would seem that the drug might be decidedly valuable in the dangerous algid stage of pernicious malarial fever. Although it has been employed to combat the collapse caused by the administration of chloroform, the results have not been so satisfactory as the theory of its action would indicate.

TOXICOLOGY

So far as is known, only one death has occurred from the use of amyl nitrite. This was a patient suffering from pulmonary tuberculosis who took a large quantity by inhalation; but in a considerable number of instances very alarming symptoms have been caused by it, and several instances are on record in which very small, and even minute, doses produced unconsciousness.

Treatment.—If serious symptoms arise from its use vomiting must be caused, if necessary, by apomorphine or other emetics. Its effects should then

be counteracted by the employment of artificial respiration and by the subcutaneous injection of strychnine and digitalis, the latter of which has an antagonistic, although somewhat slowly developed, action on the circulatory system. Other measures recommended are the exhibition of ammonia by inhalation, by the mouth, or by intravenous injection, the hypodermatic use of atropine or ether. At the same time cold water or an ice bag may be applied to the head, and a sinapism to the epigastrium. A hot mustard foot-bath may also be given, the patient being kept in a recumbent position.

GLYCERYL TRINITRATE

For the Preparations of Glyceryl Trinitrate *see* p. 104.

Action of Glyceryl Trinitrate

The spirit of glyceryl trinitrate is at first sweetish to the taste, but afterward, gives an impression of aromatic pungency. Its action is practically the same as that of amyl nitrite, but its effects on the system are produced with less rapidity and last considerably longer. The **headache** caused by it is frontal, and of great **severity,** and often persists for hours after the other effects have disappeared. Glyceryl trinitrate (nitroglycerin or glonoin) has a similar action to that of amyl and other nitrites due to the fact that it is readily converted into nitrites in the presence of alkalies, a change which has been demonstrated to take place in the blood. There appears to be a very great difference in the susceptibility of different individuals to the influence of this drug. While in one person 0.0013 gm. (1/50 gr.) may give rise to its full physiological effects, it may take twenty-five times that amount to produce the same result in another. Very small doses have been known to cause unconsciousness and complete disappearance of the pulse at the wrist. After toxic quantities there is a marked failure of cardiac action. Deaths have been reported from over-doses of the drug, and in these there were vomiting and purging, while the immediate cause of the fatal result seemed to be failure of the respiration. It may be mentioned that, after gradually increasing the quantity, as much as 0.40 gm. (6 gr.) of the remedy for a dose has been given regularly, not only without any serious consequences, but with apparent advantage.

Therapeutics of Glyceryl Trinitrate

Its most important use is for the relief of symptoms associated with the **high tension pulse of chronic renal degeneration.** Here the

dose should be rapidly increased until relief is obtained. In general, it is much relied upon in habitual high pressure, especially of arterial sclerosis in which the increased peripheral resistance is developing, or has produced, cardiac hypertrophy. It is also of service in many of the affections in which amyl nitrite is used, and has the advantage of being more lasting in its effects. Among these may be mentioned so-called asthma, angina pectoris, cardiac failure, sea-sickness, reflex vomiting, gastralgia, hepatic colic, hiccough, neuralgia of the fifth nerve, migraine when the face is pallid, neuralgic dysmenorrhœa, epilepsy, and tetanus. In angina pectoris, in which amyl nitrite is generally to be preferred if the utmost promptitude is required, it will naturally prove of the most benefit in instances characterized by high tension of the peripheral vessels. A patient subject to attacks of angina may take a sufficient dose of the remedy a few minutes before making any exertion which experience has shown is likely to bring on a paroxysm, or he may be able to prevent the attacks by using minute doses at frequent intervals during the entire day. It is much employed to relax the coronary arteries and thus improve the nutrition of the heart, although the attacks of angina may not be entirely dependent upon their spasm. In heart troubles, whether valvular disease is present or not, it often affords efficient relief, and in the various forms of cardiac dyspnœa it is of great service. It appears to do good by restoring or approximately restoring, at least for a time, the normal relationship between the force of the heart's action and the resistance of the vessels, and the pulmonary circulation itself is no doubt favorably affected by its action. Its beneficial effects are not so much due to any direct action on the heart as to its diminishing the resistance against which the systole is performed; so that the contraction of the ventricle is rendered more complete, and the output of the heart increased. It has been noted that the continuous dyspnœa met with in some instances of cardiac failure is less amenable to such relief than dyspnœa which is more paroxysmal in character. The remedy may often be combined very advantageously with digitalis in organic disease of the heart, in order to neutralize the marked vaso-constriction caused by that drug. Digitalis has unquestionably been used far too indiscriminately in cardiac affections; but it is true that during the past few years, in which the nitrites have been commonly used in this way, digitalis has been productive

of much less harmful results than formerly. Glyceryl trinitrate is, then, an efficient and generally safe remedy, and it can be given, in sufficient frequency and quantity to secure the desired action, for long periods without ill effects. It has been recommended in the algid stage of cholera and, injected subcutaneously, has been found of service in poisoning by illuminating gas. The severe headache which it is apt to produce is found in a considerable proportion of patients to disappear after repeated employment.

SODIUM NITRITE

For the Preparations of Sodium Nitrite *see* p. 104.

Action of Sodium Nitrite

External.—Locally applied, sodium nitrite, like amyl nitrite tends to destroy the functional activity of the tissues.

Internal.—Under the effect of a moderate dose of sodium nitrite the heart's action is slightly quickened and the pulse tension falls. There may or may not be some feeling of fullness in the head, but not often any throbbing, and there is generally no flushing of the face. With larger doses the **fall of tension** is marked and the same characteristic symptoms in general are produced as after use of amyl nitrite. Sometimes profuse perspiration and more or less cyanosis are seen, and faintness and nausea may occur. In those especially susceptible to the influence of the drug, partial unconsciousness and collapse may result. It is both absorbed and eliminated more slowly than either amyl nitrite or glyceryl trinitrate, and its effects on the system are very much more permanent than those of either. One disadvantage connected with its administration is the eructations to which it frequently gives rise, and another is the irritation of the gastro-intestinal mucous membrane. The greater part of the nitrite, which is absorbed, is excreted as nitrate in the urine, but some of it may remain unoxidized.

Therapeutics of Sodium Nitrite

The action of this agent, though apparently milder and less certain in effect, is analogous to that of amyl and other nitrites, and it may be employed in the various conditions in which these drugs

are of service, but as a matter of fact, however, it is much more rarely used. Wherever an immediate and powerful effect is desired both are to be preferred to it, and while its effects may be more lasting, glyceryl trinitrate is so extremely easy of administration that its repetition at sufficiently frequent intervals will prolong its influence to any required extent. If the remedy must be administered over a long period of time as in **Raynaud's disease** or erythromelalgia, to dilate the arteries in these forms of local spastic contraction, sodium nitrite is preferable. In some instances, however, it may be found to act more satisfactorily and as it is much less likely to produce severe headache than the latter, it may be advantageously substituted for it for patients to whom this is an objection.

SPIRIT OF NITROUS ETHER

For the Preparation of Spirit of Nitrous Ether *see* p.103.

Action of Spirit of Nitrous Ether

External.—When applied to the cutaneous surface it quickly evaporates, giving rise to a slightly **anæsthetic** effect.

Internal.—Its principal value is as a **carminative** and **diffusible stimulant.** It also has some antispasmodic influence, and acts as a mild sedative to the nervous and circulatory systems. Its physiological action as a nitrite is feeble as compared with that of other nitrites, although its effects in this respect are doubtless enhanced by the alcohol entering into its composition. However, some of the disappointments in obtaining expected results may be due to the fact that preparations of this drug which are encountered in the pharmacies are often of inferior strength.

Therapeutics of Spirit of Nitrous Ether

Externally, it sometimes proves a soothing application to the forehead in neuralgic headache. This time-honored remedy has a limited sphere of usefulness as a **diuretic** and **diaphoretic** in mild febrile conditions. It may be given with good effect to children, particularly, suffering from **feverishness** with nervous symptoms or mental excitement. Here it often has a pleasantly calmative influ-

ence to which possibly the contained alcohol contributes, quieting the restlessness and promoting sleep. It is a grateful carminative, and is useful, especially when associated with aromatic spirit of ammonia, in allaying nausea. It is frequently employed as a constituent of expectorant mixtures, also in combination with diuretics.

2. Vaso-constrictors. (*a*) Vegetable Astringents.

TANNIC ACID

For the Preparations of Tannic Acid *see* p. 187.

Action of Tannic Acid

External.—Locally, tannic acid is an **astringent** and **hæmostatic**, and its characteristic effect is the precipitation of gelatin and proteids, thus causing shrinking of the tissues and checking of secretion, and in addition many alkaloids and glucosides. The precipitate thus formed is dense and resists putrefaction. Tannic acid is very slightly irritant, but this effect is more than counterbalanced by its astringent action. It apparently has no action on the unbroken skin, but on mucous membrane it has the effect of causing more or less coagulation in the cells, by direct action on the cells themselves; precipitating the albumin of the secretions, which it diminishes, and forming a layer of albumin tannate which is protective and antiseptic. Applied to a bleeding surface, it thus has a hæmostatic action, coagulating the effused blood and plugging the vessels with clots, and still further tending to check hæmorrhage by the constriction of the vessels caused by the contraction of the coagulum formed within the tissues.

Internal.—Its taste is bitter, and in the mouth it produces a feeling of dryness and stiffness. The sense of taste is partially lost, and the movements of the tongue are interfered with in consequence of the coagulation of the superficial layers of proteids, both within and without the epithelium, which causes a roughness of the surface of the mucous membrane, so that the tongue cannot glide over it easily. In the throat the same feeling of astringency is experienced. Nausea and vomiting may sometimes, but not often, be caused by the drug. In the intestines it diminishes the glandular secretions, so that constipation results, and the fæces become hard and scanty. The increased

consistency of the stools is thought to be due to the layer of coagulated protein acting as a protective to the bowel, lessening its irritability, and thus retarding its movements; so that there is longer time for the absorption of the fluid part of its contents. In the stomach tannic acid is found to combine with and precipitate any proteid substance with which it comes in contact, but, as digestion proceeds, such combination is broken up, the peptones not combining with this agent in acid solution; and the **astringent action** is therefore exercised on the walls of the stomach and intestines. By lessening the mucus in the intestines it may lead to a diminution of the number of bacteria. When given in large amount, however, it sometimes causes gastro-intestinal irritation and diarrhœa. Only about one per cent. of the tannic acid swallowed reappears in the excretions, as sodium gallate; the rest would seem to undergo complete oxidation in the tissues. A small proportion is occasionally eliminated by the bowel unchanged, but the greater part is converted into sodium gallate, some of which often passes out both in the stools and the urine. No evidence has been presented that tannic acid, since it is changed into sodium gallate, exerts any influence after it has been absorbed. When it is injected intravenously, the precipitate produced is believed to lead to the formation of emboli.

Tannic acid is the chief principle of all the vegetable astringents, although not always the same chemical body, but the various acids, such as kinotannic, all have in common the power of precipitating albumins and other properties characteristic of the acid. The differences in the intensity of their effects is explained by the fact that some are more energetic precipitators of albumin than others, and that many of the drugs contain gum, resin and others matters which affect the solubility of the tannins.

Therapeutics of Tannic Acid

External.—Tannic acid is a very useful remedy, and its applications are extensive both in surgery and medicine. It is employed to control bleeding in various parts of the body, and it may, if practicable, be dusted on the part, or be applied on the form of the glycerite or of styptic collodion (a 20 per cent. solution of tannic acid in collodion). The latter is of special service in uniting incised wounds and protecting lacerated wounds. When applied on wounded or abraded surfaces it checks the oozing and forms a firm coating in

which the coagulated blood and secretions participate, and which excludes the air from the part.

Aside from its local **astringent** and **hæmostatic effects,** tannic acid is of value locally for preventing or checking putrefactive changes in the tissues. Among the conditions in which its application is useful may be mentioned aphthous ulceration of the mouth, spongy gums, mercurial salivation, relaxation of the uvula, pharyngitis, nasal catarrh, otorrhœa, laryngitis, chronic inflammations of the conjunctiva, leucorrhœa, urethritis, cystitis, hæmorrhoids, burns, chilblains, ulcers and other sores, and moist cutaneous eruptions. For local use the glycerite is the most satisfactory preparation of tannic acid, and the official strength may be readily altered to suit special conditions. A concentrated solution, two parts of glycerin in one of tannic acid, may be made by the aid of moderate heat, and will be found useful to prevent sore nipples if applied daily during the later months of pregnancy. The glycerite, in the strength of one part to eight of water, makes an excellent gargle. For pharyngitis and tonsillitis the troches are convenient, and an insufflation of tannic acid and starch may be used for the larnyx, as well as the fauces. The ointment of nutgall and opium (14 to 1) is a favorite application for piles. In affections of the rectum, tannic acid is recommended in the form of a suppository each containing 0.20 gm. (3 gr.), and in those of the uterus in the form of a pencil made with tragacanth (4 to 1). The glycerite is regarded as an excellent application for catarrhal inflammation of the cervix uteri, and even in cancer of the uterus is efficient in moderating the discharge and allaying odor. Solutions (1 to 50) in water may be injected into the bladder for cystitis and into the urethra in the treatment of subacute gonorrhœa and gleet. The decoction of nutgall, employed as a high rectal injection, destroys the thread-worm. The tannic acid ointment is sometimes of service in such skin affections as herpes, intertrigo, and moist eczema, checking the discharge and allaying itching and irritation. Ulcers of the rectum and anus and fissures of the anus are sometimes effectively treated by the application of the powder of tannic acid or a solution of iodine with tannic acid.

Internal.—As an internal remedy tannic acid is of little value. It is often prescribed in internal hæmorrhages as those of the gastro-intestinal tract, where, if given in sufficient quantity, there may be some opportunity for it to exert its local action, chiefly astringent.

In certain forms of diarrhœa its **astringent action** is of considerable value, and it may prove useful in checking the looseness of the bowels sometimes caused by such remedies as cod liver oil. In these conditions, however, the tannic acid, as such, is seldom used, as it is liable to derange the stomach and to form compounds with the albumin before it reaches the intestine, and such agents as kino and gambir, which owe their astringent qualities to tannic acid, are generally selected in the treatment. Remedies of this kind, whose activity depends on their containing tannic acid, differ from the pure drug in that the acid is only slowly dissolved out from the colloid mass, and therefore acts less on the stomach and affects a greater length of intestine. As a temporary expedient in **poisoning with metallic compounds,** such as tartar emetic, and with alkaloids, the exhibition of tannic acid may serve a useful purpose; but it should always be followed by the prompt emptying of the stomach, as otherwise the tannate formed becomes gradually dissolved in the fluids of the alimentary canal. In the early stage of cholera, tannic acid enemata, carried beyond the ileo-cæcal valve, have proved to be of service; the injections being composed of 20 gm. (5 dr.) of tannic acid disolved in 2 liters (2 qt.) of water, with the addition of 2 mils (30 ♏) of laudanum and 45 gm. (1½ oz.) of powdered acacia. Certain individuals, it has been found, are peculiarly susceptible to the action of tannic acid, which in such instances produces local irritation, and even inflammation, wherever it is applied. This remedy should never be used hypodermatically.

GALLIC ACID

For the Preparations of Gallic Acid *see* p. 188.

Action and Therapeutics of Gallic Acid

Gallic acid, given by the mouth, is absorbed, and is excreted to some extent by the kidneys, but much of it disappears in the tissues, apparently by oxidation. It does not, like tannic acid, precipitate proteids, and has therefore no local **styptic** or **astringent** effect. It can be taken in very large quantity without producing any symptoms, its action being simply that of a weak organic acid.

It has been employed to a very considerable extent to produce the supposed remote astringent effects of tannic acid, which, as has been seen, becomes largely converted into its sodium salt in the body.

Therefore, it should be prescribed when **astringent effects on** the tissues elsewhere than the intestinal canal are desired, and it is claimed that in the treatment of renal hæmorrhage it is more uniformly successful than any other remedy. It is also believed to be serviceable in pyelitis, pyelo-nephritis, and catarrh of the bladder, as well as in chronic bronchial catarrh when the latter is the sequel of acute bronchitis or the results of the irritation extending from disease of the parenchyma of the lung, or when it is produced by mitral or tricuspid regurgitation. Others hold that, combined with opium, it is one of the best remedies in diabetes insipidus. It is also stated to have proved efficient in pyrosis, an annoying symptom of various dyspeptic conditions.

PYROGALLOL

For the Preparations of Pyrogallol *see* **p. 188.**

Action of Pyrogallol

Pyrogallol, in its effects on the system, is more nearly related to phenol than to gallic acid, acting directly upon the blood and, secondarily, upon the kidneys. The red corpuscles become shrunken and the greater part of their hæmoglobin, escaping into the plasma, is converted into **methæmoglobin,** so that marked dyspnœa, is likely to result. The color of the blood is changed to a brownish-red, in consequence of which the skin and mucous membranes become discolored, and if the toxic effect is not too acute, icterus follows, and both hæmoglobin and methæmoglobin are excreted in the urine. In the kidney the poison sets up an inflammatory process, which is indicated by the presence in the urine of albumin, epithelial casts and products of the decomposition of blood, and which may lead to the production of uræmic convulsions. It is excreted in the urine partly as an ethereal combination with sulphuric acid and partly as unknown oxidized products, which give the secretion a dark brown or black color. When death results, it appears to be due to the changes in the blood and nephritis resulting therefrom, rather than to any direct effects of the drug on the central nervous system. Poisoning has been observed to have taken place after absorption from the skin. Pyrogallol precipitates albumin, and has a deep and strong local **irritant** action. In a 1 or 2 per cent. solution it is

decidedly **antiseptic.** When it is applied in solution or ointment, but not in flexible collodion, it **stains** the skin, but not permanently; linen and clothing are, however, permanently darkened. Its incautious application may cause inflammation of the skin, which may result in extensive ulceration and sloughing.

Therapeutics of Pyrogallol

Pyrogallol is rarely, if ever, given internally, but is almost exclusively used in the local treatment of various diseases of the skin, but it should not be applied over too large a surface, on account of the danger of absorption. The curative effect of pyrogallol in skin affections is attributed to its irritant and antiseptic properties, but is referred by some to its **reducing action.** It undoubtedly has very considerable germicidal power. It may be employed either in the form of an ointment, or dissolved in flexible collodion. Jarisch's ointment (1 to 8) is entirely too strong for ordinary use. Psoriasis, pityriasis versicolor, ringworm, sloughing phagedæna, and syphilitic lesions of the integument are among the affections in which it has proved of value. It has also sometimes been used with good effect in lupus, leprosy and epithelioma. Before it is employed an oil should be thoroughly applied, and wiped off, to remove scales and other morbid products. In some conditions it is recommended that the remedy should be mixed with a powder, such as kaolin or starch, and dusted over the affected part.

GAMBIR

For the Preparations of Gambir *see* **p. 188.**

Action and Therapeutics of Gambir

Gambir is a powerful **astringent,** owing to the tannic acid entering into its composition, but aside from this has no special action.

Locally it is useful in relaxation of the soft palate and uvula and in simple pharnygitis it may be employed in troches or in the form of a gargle. It is also used as a mouth-wash for spongy gums and as an ingredient of dentifrices. The compound tincture is a favorite remedy in **diarrhœa** arising from various causes. If there is any source of irritation in the intestinal tract, or a catarrhal condition of the bowel, its administration should be preceded by a purge, such as castor oil or magnesium sulphate. In children it is often given in combination with paregoric and chalk mixture.

KINO

For the Preparations of Kino *see* p. 189.

Action and Therapeutics of Kino

Kino is **astringent,** kinotannic having the same effects as tannic acid.

In diarrhœa, kino, gambir, and others of the vegetable astringents act more efficiently than tannic acid given as such. The tincture is considered one of the most efficient means of combating the **atonic diarrhœa** resulting from the disuse of opium or morphine. It is often serviceable in relieving **pyrosis.** It is sometimes applied as a stimulant dressing to indolent ulcers, and is also employed in astringent gargles and in mixtures for injection in gonorrhœa.

HAMAMELIS

For the Preparation of Hamamelis *see* p. 190.

Action and Therapeutics of Hamamelis

Although extravagant claims have been made, no experimentation has shown that it has any physiological action beyond that which might be expected from an agent rich in tannic acid.

Externally, hamamelis water is believed to have a sedative as well as astringent action upon congested or inflamed tissues, and constitutes an **agreeable application** in a variety of conditions. Thus, it is used for sprains, bruises, and superficial inflammations, and, diluted, in inflammations of the gums, pharyngitis and nasal catarrh. It is also used as a lotion for freckles, hyperidrosis, carbuncle and lupus erythematosus, and to relieve the stiffness of chronic rheumatism. Some of the benefit which has been claimed for this preparation is doubtless due to the alcohol which it contains. Care should be taken to avoid the commercial specimens in which wood, has been substituted for grain, alcohol.

(*b*) Mineral Astringents.

LEAD

For the Preparations of Lead Salts *see* p. 84.

Action of Lead Salts

External.—Upon the unbroken skin the salts of lead have little or no action, though the integument is discolored by the use of some

of them. Upon denuded surfaces they have a decided **astringent** effect, causing the **contraction** of the small **blood-vessels,** and upon ulcers, coagulating the albumin of their discharge and the protoplasm of the neighboring superficial cells; in consequence of which a protective coating is formed for the more normal structure beneath. In addition, by reason of the local depletion resulting from vaso-constriction and also, it is thought, because of a depressant effect upon the sensory nerve-endings, they have a marked **sedative** action. Any of these salts, if sufficiently concentrated and applied in sufficient amount, may be irritant and to a certain extent corrosive.

Internal.—*Alimentary Canal.*—Lead salts have the same powerfully **astringent** effect upon the mucous membrane of the alimentary tract as upon the abraded skin. While they may occasion sufficient corrosion to be absorbed, this never appears to be sufficient to produce acute fatal poisoning from systemic effects. Almost the only result caused by ordinary doses is constipation. When given in large amounts they act as gastro-intestinal irritants, causing salivation, thirst, difficulty of swallowing, abdominal pain, vomiting and diarrhœa. There is a burning, sweetish taste in the mouth, and the vomited matter consists of whitish fluid containing curdy material, the color being due to the formation of lead chloride from a combination of the lead with the hydrochloric acid of the gastric juice. In consequence of the astringent action of lead salts, the purging is not as marked as in the case of most irritant poisons, and sometimes there is constipation. If the bowels are moved, the passages are likely to be of a blackish hue from the presence of lead sulphide, and both the stools and the matters vomited may contain blood.

Absorption and Excretion.—In whatever form or whatever dose lead is given, a small quantity is promptly absorbed, and while this may be incapable of producing any immediate symptoms, its excretion is very slow, and consequently cumulative action is liable to result. Lead has been shown to be always absorbed in the form of soluble proteid combinations, and these may be formed from lead compounds, even the sulphate, which are perfectly insoluble. Lead is excreted by intestinal epithelium, in the urine, bile, saliva and milk, and probably by the glands of the skin. It is recovered, if its absorption has been prolonged, from both the urine and fæces. In the form of the sulphide the lead is sometimes deposited on the

edge of the gums giving the characteristic "lead line," which is also known as Burton's line, due to the presence of hydrogen sulphide produced by the action of bacteria. This is not often met with where the teeth are sound and kept clean. There is frequently a similar line at the junction of the skin and the anal mucous membrane. In the kidneys lead causes decided irritation during the process of excretion; so that nephritis is found to be a frequent result of acute poisoning and an invariable one of chronic poisoning. A remarkable circumstance in connection with lead-poisoning is the frequency of gout in its subjects, in one-fourth of the patients there is a history of saturnism; so that it would appear that the latter predisposes to gout, if it does not actually cause it. In districts where ordinary gout is rare, however, lead-poisoning seldom leads to it. The nephritis of chronic poisoning is sometimes, no doubt, in part secondary to this disease, and also to the arteriosclerosis induced by the lead. Fatty degenerations are likewise found in the kidneys, liver, and other organs. The lead which is retained in the body is stored in the liver, kidneys, brain, bones and muscles, but chiefly in the liver. Only traces of it are found in the blood.

Blood.—In chronic lead-poisoning there is always anæmia, which is due at first, to the constriction of the peripheral vessels and subsequently, to diminution of hæmoglobin and the number of red corpuscles as well as to their degeneration. The white corpuscles are generally, though not invariably, increased. Not infrequently jaundice results from the breaking up of red corpuscles and the liberation of large amounts of hæmoglobin.

Nervous System and Muscles.—In what is known as *encephalopathia saturnalis* the disorders met with are for the most part of cerebral origin, although the lower divisions of the central nervous system are also sometimes involved. Upon the cortex, which is chiefly affected, there is produced an irritation, followed by paralysis, and the effects are both sensory and motor, the latter being the more pronounced. There are usually muscular contractures and then choreic movements. In some instances convulsions occur, and these are sometimes due to uræmia resulting from the nephritis, and at others to the lead itself. Later, paralysis succeeds the motor stimulation. In addition, there is delirium, followed by depression and finally by coma, and the latter may also be uræmic. In necropsies of some of the patients dying from lead-poisoning atrophy

of parts of the cerebrum or hæmorrhages, as well as disease of the blood-vessels has been observed. In prolonged lead-poisoning degenerative changes may occur in the anterior columns of the spinal cord. On the motor system the effects produced are neuritis, paralysis and atrophy. Their usual seat is no doubt in the peripheral nerves and muscle cells, though the central nervous system would appear to be involved in some instances. A common characteristic of lead-poisoning is the "wrist drop" or "painter's palsy," and this is probably attributable in part to paralysis of the extensor muscles and partly to the active contracture of the opposing flexor muscles. The most prominent of the peripheral effects is **lead colic,** due to violent contraction of the intestinal muscles, probably from stimulation of the nerve-endings. As it is largely relieved by nitrites and other agents which dilate the blood-vessels, it is inferred that a primary vaso-constriction is one of its causes. As a spasm of the intestine forces the blood out of the splanchnic area, the general blood-pressure is raised and the pulse is slowed and rendered tense. The pain, which is intense and grinding in character, is located principally in the umbilical region, and the abdomen is retracted and hard. Paroxysms of the most acute agony are followed by intervals of comparative ease. The colic lasts for several days, or a week, and then disappears, but is apt to recur at intervals. Other affections, apparently, of the peripheral nerves are anæsthesia of various parts, lasting perhaps one or two weeks, and lead arthralgia, which consists of sharp lancinating or boring pains in the joints, bones, or the flexor muscles around the joints, and which generally appears and disappears quite suddenly. Neuralgias are occasionally observed, and these are probably sometimes due to peripheral neuritis and sometimes are of central origin. One of the rarer phenomena of lead-poisoning is amblyopia, in which the sight may be only rendered somewhat dim or lost entirely. This may be due to optic neuritis, which, unless arrested early, leads to atrophy of the nerve, to uræmia with an effusion into the optic sheath, or to so-called albuminuric retinitis.

Uterus.—Lead is very fatal to the life of the fœtus, and under its influence abortion is liable to occur, or the child be still-born. It has been suggested that this result is probably due, in part at least, to the poor quality and diminished quantity of the blood supply.

Therapeutics of Lead Salts

External.—Lead salts, in the form of lotions and ointments, are used, for both their **sedative** and **astringent** action, in a great variety of acute local inflammations. The solution of the subacetate is sometimes successful in aborting a felon. For most other purposes it is apt to be too irritating, but when diluted may be applied with advantage to contusions, acute eczema, erysipelas, and inflammations of various kinds. This solution may also be employed to soothe in such affections as urticaria, paræsthesia, etc. Burow's solution, which is a solution of aluminum acetate, often employed for the same purposes, if made from alum and lead, instead of calcium acetate, may contain a precipitate of lead. This should be filtered out as it may cause poisoning. A lotion of lead and opium has long been a favorite application for relieving pain and inflammation. It may be prepared by mixing extract of opium, 1, with 100, each, of lead water and water. Lead lotions, to which zinc sulphate is often added, are used for injections in gonorrhœa, gleet, vulvitis, leucorrhœa and otorrhœa. They were formerly also employed in conjunctivitis, but have been abandoned as applications for the eye, for, if ulceration of the cornea be present, the white precipitate formed is liable to lead to permanent opacity. Diachylon ointment is useful in seborrhœa, hyperidrosis, eczema, dermatitis, herpes zoster, and sycosis. Hebra's diachylon ointment is made by melting equal parts, by weight, of lead plaster and flaxseed oil; to which balsam of Peru and a little oil of lavender are sometimes added. Even in chronic diseases of the skin lead salts are often of service on account of their soothing and astringent effects. Lead plaster is excellent for preventing bed-sores and as a basis for other plasters, and is used to protect parts of the body exposed to chafing by splints or other apparatus. If applied for too long a period, it may cause poisoning. The nitrate, in very dilute solution, may be used also as a lotion in leucorrhœa and to correct the fetid odor of discharges from ulcers, etc. In hæmorrhoids, when there is much pain and a sense of burning heat at the anus, the addition of lead water to the ointments frequently used in such cases often affords marked relief.

Internal.—Practically, however, the only lead salt which is used for internal administration is the acetate, which is highly prized for its astringent and hæmostatic effects. It has been largely employed

for the purpose of arresting hæmorrhage from the lungs, but is more adapted to the **hæmatemesis accompanying gastric ulcer.** In this affection it is also a very useful remedy in other ways; not only relieving pain, but modifying the ulcerated surface and checking inflammatory action as well. It is sometimes of service in chronic catarrh of the stomach, with gastralgia and pyrosis. It has also been employed for the obstinate diarrhœas of tuberculosis, enteritis or colitis. It is used after surgical operations about the rectum and anus for producing obstipation. Theoretically it is incompatible with preparations of opium, but, notwithstanding this, it is very often advantageously combined with them in painful affections of the stomach, as well as in various forms of diarrhœa.

If lead acetate is administered for any length of time there is more or less risk of **plumbism** being induced, and some persons are peculiarly susceptible to the poisonous action of the drug. Its effects should therefore always be watched with care. Even the external application of lead solutions or ointments have occasionally been attended by colic and other untoward symptoms.

TOXICOLOGY

ACUTE LEAD POISONING.—The acetate is most frequently taken, and a very large quantity of it is required to produce a fatal effect. Owing to the fact that so much of the drug is generally vomited, acute poisoning rarely terminates fatally. The gastro-intestinal symptoms are followed by great weakness, coldness of the surface, and collapse. In some instances, in which recovery has taken place, the patients have later suffered from chronic lead poisoning, but it has been pointed out that, apart from these, nothing in the course of the acute poisoning suggests the absorption of lead; all the symptoms being obviously due to the local effects on the alimentary tract, and to the subsequent collapse. *Post-mortem.*—In the stomach and intestine such signs of irritant poisoning as redness, excoriation and softening are found.

Treatment.—The stomach should be washed out or emetics (*see* p. 380) given. The precipitation of the lead should then be attempted by the administration of sodium or magnesium sulphate, or, if such sulphates are not procurable, by white of egg or milk, forming an insoluble albuminate. If collapse is present, it should be combated by the administration of stimulants, by hypodermatic injection or by the mouth, and the external application of warmth.

CHRONIC LEAD POISONING.—This is so common that the sources of accidental poisoning should be borne in mind. The most important are: soft water, carbonated waters and alcoholic drinks (beer) which have passed through lead pipes or been stored in receptacles lined with lead. The occupations of painters (*colica pictonum*), plumbers, typesetters, gold miners, white lead workers, potters, storage battery workers, glaziers (Devonshire colic), because the men will not

wash their hands before meals nor use ordinary care; lead hair dyes and face powders, biting leaded white thread, eating certain canned fruits (lead solder), sheet-lead (tin-foil) about tobacco, filling holes in mill stones with lead, playing with tin (lead) soldiers by children, use of lead ointment on burns, prolonged use of lead plasters, lead bullets in flesh, white or red lead used for preparing rubber for vulcanizing, lead plates in dentistry, the use of lead chromate to color buns yellowish, have all been followed by chronic plumbism. Most of the symptoms and effects have been mentioned. Not only the extensors of the hand, but any muscle may be paralyzed, sometimes almost all the muscles of the body seem to be affected, and it is a clinical observation that such muscles are very refractory to electricity. The supinator longus, however, usually escapes, the reason for this apparently being that the supinator is not an extensor muscle. Lead is regarded as perhaps the best example of a poison, which is comparatively free from danger in a single dose, however large, but which becomes fatal in the most minute doses, if these are taken for a sufficiently long time.

Treatment.—The first thing to be done is the removal of the patient from the danger of further poisoning. In the general treatment reliance is placed upon potassium iodide, saline purgatives, diuretics, and the use of hot baths and massage to promote elimination, and the improvement, by appropriate measures, of the patient's nutrition and strength. Potassium iodide is universally employed, and appears to have a remedial effect, though the manner of its action is not clearly understood. It has generally been supposed to accelerate the elimination of the poison by the kidneys, but recently it has been denied that it has any influence on the excretion either by the urine or by the intestine, by which most of the lead escapes from the body. Baths of sulphurated potassa are quite efficient, especially if the patient is afterward well soaped, then thoroughly rinsed off, and finally rubbed down with a rough towel. For the various effects of lead in the system special treatment is required. For the colic, opium or morphine is often necessary, alum is of great service, and sulphuric acid is also useful (*see* p. 474). Often in chronic lead poisoning it is found that cathartics fail to act unless morphine is given to overcome the intestinal inhibition produced by the irritation resulting from the lead. Opiates may also be required for the relief of the arthralgia. For the paralysis strychnine may be used, but the main reliance is to be placed on electrical stimulation and massage. If the muscles contract in response to the faradic current, this should be employed, but if they do not, the galvanic current. Nephritis and gout due to plumbism should be treated in the same way as if resulting from other causes, while the cerebral symptoms must be dealt with according to the special manifestations present.

Prophylaxis is of the greatest importance, and the public should be more generally instructed in regard to the insidious dangers of lead. Special precautions are required in lead works and paint factories, and in exposed trades. Dust should be avoided as much as possible, and where this is necessarily present, thorough ventilation of the rooms should be insisted upon. The necessity of frequent bathing and of thorough washing before meals ought to be impressed upon the workmen. Food should not be permitted upon the premises, and the clothing should be changed before leaving the work. The habitual employment of milk in large quantity as a food has been recommended as of service. Sul-

phuric acid lemonade is quite generally made use of as a prophylactic, but not so much reliance can be placed upon it. Weak and anæmic men ought not to be admitted as operatives in lead factories, and it is advisable that women should not be employed at all in them.

SILVER

For the Preparations of Silver Salts *see* p. 81.

Action of Silver Salts

External.—The local action of silver salts is in general, **astringent** and **hæmostatic,** and they are also **irritant** and **corrosive,** especially the nitrate. Their astringent effect is due to the formation of a protective layer of albumin. While dilute solutions of the nitrate may possibly have some vaso-constrictor effect, if the salt is applied in sufficient strength to induce irritation, the blood-vessels will become dilated in consequence of this. Even in dilute solution silver is apt to be irritating to the skin, while stronger solutions vesicate, and the solid nitrate causes an eschar. This is at first of a whitish color, but later turns black from the reduction of silver in light. The corrosive action of silver is less deep than that of some other metals, as its penetration is interfered with by the precipitation of silver albuminate. On abraded surfaces and mucous membranes dilute solutions act as astringents, but concentrated ones are caustic. The silver salts possess very considerable **antiseptic** power, and they tend to diminish suppuration by rendering the walls of the blood-vessels less permeable to inflammatory products. At the same time, they tend to prevent the further penetration of bacteria, and hinder their development by rendering the culture-ground unsuitable. Silver nitrate not only coagulates the proteids of the micro-organisms, but is also **antiseptic** from the specific effects of the metal.

Internal.—Silver salts appear to have no astringent action when administered internally. In the stomach the soluble salts are probably converted into the chloride and albuminate, though the form in which the metal is absorbed is uncertain. As it is mostly reduced to inactive compounds soon after entering the body, the use of silver does not lead to general poisoning. When it is given for prolonged periods, however, a slight proportion of the metal ingested is absorbed, this absorption being shown by a **pigmentation** of the skin

and mucous membranes known as **argyria,** due to the deposit of minute granules which were formerly supposed to consist of metallic silver, but which are now thought to be an organic compound. They are also found in many internal organs, but are chiefly present in the connective tissues of the body. Argyria may result from the prolonged use of silver nitrate solution as a local application to the eye, nose and throat. It is believed that most of the silver passes through the alimentary canal unabsorbed, and the slight amount absorbed remains imbedded in the tissues. When silver is introduced into the circulation by subcutaneous injection, its effects are found to differ from those of other metals in the predominance of nervous symptoms. The action is chiefly upon the central nervous system, and especially in the **medulla oblongata,** as shown by a rise of blood-pressure and slowing of the pulse, in consequence of increased activity of the vaso-motor and vagus centers. This stimulation is followed by paralysis; the blood-pressure falling, and the respiration becoming slow and labored and then failing altogether. The heart is comparatively unaffected, and may continue to beat for some time after the respiration has ceased. There is also motor paralysis, beginning in the lower extremities. The secretion of bronchial mucus may be so markedly increased that it may lead to asphyxia, and this is thought to be due to injury to the epithelium. Silver nitrate, in solid form or concentrated solution, is a **gastro-intestinal irritant** and is corrosive.

Therapeutics of Silver Salts

External.—Metallic silver in very thin sheets, is used as a surgical dressing for wounds and burns, constituting a protective covering which may be painlessly removed and renewed and which prevents or limits suppuration. Silver wire has a considerable use in surgery. Silver nitrate is used as a **caustic** whenever a limited and clearly defined action is required, but is of no value for producing a deep escharotic effect. It is often applied to the bites of animals, but it is a dangerous caustic to employ in deep bites, for the pellicle of silver albuminate retains the poison in the wound. The solid nitrate is used also to destroy warts and other growths, to restrain the bleeding from leech-bites, and as an application for ulcers in various parts, for venereal sores, and in catarrh of the cervix uteri. In erysipelas the disease may sometimes be arrested by delimiting

the affected area with silver nitrate. Boils in the eye-lids have been aborted by its early use, and it has also been employed with good results in eczema, lichen, herpes and other cutaneous affections when occurring in circumscribed patches. The moulded nitrate is a good application to granular lids, chancroids, small-pox vesicles, to prevent pitting, and in general to excite a healthy action of granulating surfaces. The injection of a strong solution of silver nitrate in the early stage of the disease has been advocated by some as a method of aborting gonorrhœa. Uniting, as it does, an irritant and stimulating, with an astringent effect, lotions are often of service as an application for chronic pharyngitis or laryngitis and indolent ulcers, or as an injection in gleet or inflammation of the cervix uteri, while weaker solutions are used for various forms of ophthalmia. *Ophthalmia neonatorum* is successfully treated by early applications of a 1 per cent. aqueous solution of silver nitrate. This is commonly known as **Credé's method,** but the original formula as prescribed was double this strength. A 4 per cent. solution is efficient in pruritus vulvæ and in the prevention of bed-sores. Irrigation of the bowel with a solution of from 1 to 2 per cent. is often useful in pseudomembranous enteritis, while prolapsed rectum, especially in children, is benefited by cauterization with the moulded silver nitrate.

Internal.—Silver salts were formerly employed to a considerable extent in nervous diseases, and the nitrate especially in the treatment of epilepsy. At the present day its long continued administration is wholly unjustifiable on account of the objectionable discoloration of the skin to which it gives rise. This however, so far as applications to the skin are concerned, may be obviated by repeated washings with solution of sodium thiosulphate, 1 to 8, after preliminary painting with tincture of iodine. Argyria from internal administration of silver salts is likely to be permanent. There are, however, some conditions met with in the alimentary canal in which it is considered of value, and if it is not used too freely, or for too long consecutive periods, there would appear to be little risk of inducing argyria. There is no instance on record, it is stated, of the latter having been caused by less than 30 gm. (1 oz.) of silver nitrate. Clinical experience seems to show that it is of service in hyperchlorhydria and **gastric ulcer** and in chronic gastric catarrh and gastritis, accompanied with acid eructations or with vomiting after meals. In the treatment of ulcer it is recommended that it should

only be given after lavage and be given in pill form with extract of hyoscyamus or opium. It is undoubtedly more useful if administered by instillation, in 1 to 500 solution, after a preliminary lavage, and after a few minutes removed from the stomach by thorough washing out of the organ. In intestinal ulceration it has been highly recommended; under these circumstances the drug should be administered in keratin-coated pills, in order that it may pass through the stomach without being chemically changed. Petrolatum is an excellent excipient; for this purpose various extracts, glucose and glycerin are unsuitable because they render the pills inert. In ulceration of the cæcum and rectum, as well as in dysentery, rectal or colonic injections of silver nitrate are no doubt preferable. For high injections a flexible tube should be used, and the bowel should be washed out with tepid water previous to the introduction of the silver solution. For use in stomach disturbances some prefer silver oxide to the nitrate, on account of its larger dose and less caustic properties.

TOXICOLOGY

The nitrate sometimes causes acute poisoning.

Symptoms.—These are, intense pain in the abdomen and muscular spasm, followed by vomiting and, generally, purging. The face is livid and covered with perspiration. The vomited matter is black and contains coagulated mucus. If the salt is in solution, the mucous membrane of the mouth will be covered with a grayish-white membrane, which afterwards becomes dark-colored. *Post-mortem.*—Should the poisoning result fatally, the appearances are those commonly met with in acute corrosive poisoning. Chronic poisoning or argyria shows itself by a permanent slaty discoloration of the skin, conjunctivæ and labial mucous membrane and ulcerations in the digestive tract.

Treatment.—This consists of administering a solution of sodium chloride (common salt), soothing the mucous membranes by ingestion of milk, and relieving pain with opium. The chronic form is avoided by interrupting the treatment, using eliminating remedies, and preventing staining of the skin by baths of solution of sodium thiosulphate in warm water.

ZINC

For the Preparations of Zinc Salts *see* p. 74.

Action of Zinc Salts

External.—Zinc chloride is an energetic **corrosive.** It causes much pain and penetrates deeply, but is valuable as a caustic for

the reason that its action is limited to the seat of application. It is strongly **antiseptic,** and constitutes the chief ingredient of Burnett's fluid, a well-known domestic disinfectant. Solutions of the chloride of moderate strength are astringent and slightly hæmostatic. The other zinc salts are also **astringent** and mildly **hæmostatic.** The most active of them are the sulphate and acetate; the oxide, stearate and precipitated carbonate being quite feeble astringents and even being classed as emollients.

Internal.—Zinc chloride is a violent corrosive poison to the alimentary canal, causing a burning pain in the mouth, throat and abdomen, with vomiting and purging, followed by collapse. The matter vomited is likely to contain blood and shreds of mucous membrane, and the stools may also contain blood. Zinc salts, as a rule, act as **astringents** upon the gastro-intestinal mucous membrane, as well as upon the abraded skin and ulcerated surfaces. They are believed to have a somewhat specific irritant action, affecting at first exclusively the nerve structures in the stomach which form the starting point of the vomiting reflex; consequently **emesis** occurs before there is time for corrosion, and even very large amounts may be free from danger. The most typical in its action is the sulphate, which is a very prompt emetic, so rapid that there is no time for nausea, and its depressing effects are also very slight.

Remote Effects.—The general action of zinc salts can be observed only when they are thrown directly into the circulation. Injected intravenously, they appear to depress the central nervous system, and to a less extent the heart and voluntary muscles, and to cause irritation and congestion of the gastro-intestinal mucous membrane, as well as inflammation of the kidney. Emesis is one of the effects produced, and this is thought to be probably due to the irritation of the stomach induced by the metal, rather than to any direct action upon the medullary center for vomiting. Zinc has been found to possess a special affinity for the hæmoglobin of the blood, with which it forms a compound (zinc-hæmol), but its administration has no effect on the formation of hæmoglobin. Zinc is excreted by the stomach and intestinal walls, and in much smaller amounts in the bile and urine. Of the zinc absorbed from the stomach and intestine, most is found to be contained in the liver and bile, less is met with in the spleen, kidney, thyroid and pancreas, and very little in the other tissues. Workers in zinc are occasionally the subjects of

what is known as "brass founders' ague," an affection which is apparently due to the fumes of zinc which escape in the process of casting. After a period of general malaise, followed by prolonged rigors and shivering, soreness of the chest occurs, accompanied by coughing and headache. Then profuse perspiration supervenes and the patient falls into a deep sleep, from which he awakes in ordinary health. Various obscure nervous conditions have been described as being caused by zinc in those who work with the metal, but they appear to be extremely rare, and when present may possibly be due to arsenic, lead, or other impurities occurring in zinc compounds.

Therapeutics of Zinc Salts

External.—Zinc chloride is an effective **caustic** for morbid growths, such as epitheliomata, nævi and condylomata, as well as for gangrenous sores. Canquoin's paste is a mixture of zinc chloride in varying strength with wheat flour and water. In malignant disease of the uterus the chloride has been used both in paste and in saturated solution applied by means of a tampon. Injections of zinc chloride have been used in tuberculosis of joints and in lupus, and even in the early stages of pulmonary tuberculosis minute quantities have been injected into the lung, with the object of favoring the formation of fibrous tissue and thus arresting the disease. Either alone or combined with other agents, zinc sulphate is very commonly employed as an injection in gonorrhœa and gleet and as a collyrium in conjunctivitis. The oxide, stearate and precipitated carbonate, either dusted on the part or in the form of ointment, may be employed in a variety of conditions where a **mild astringent effect** is required. The ointment of zinc oxide is perhaps more widely used than any other as a protective and slightly astringent application in acute skin affections. What is known as Unguentum Metallorum, which consists of equal parts of the ointments of zinc oxide, lead acetate, and diluted mercuric nitrate, in a serviceable application for some forms of eczema and other skin diseases, as well as for sores and ulcers.

Internal.—*Alimentary Canal.*—Zinc chloride is not given internally. The sulphate is, however, a very **serviceable emetic** in narcotic and other poisoning, where prompt and efficient action is required. It is quite safe so long as the mucous membrane is intact, for under these circumstances it is not absorbed. Practically, how-

ever, it always produces some irritation of the gastric walls, and its use should therefore be limited to instances in which the posion is not injurious to the stomach itself. Its only advantage over apomorphine appears to consist in a less degree of nausea and depression. Both the sulphate and oxide are occasionally given in chronic diarrhœa and dysentery. The oxide is useful in gastralgia, and has been recommended, usually in association with other drugs, when the following conditions are present: pain after eating, nausea, and intestinal pain, succeeded by prompt evacuation of the bowels, and the fæces being made up largely of undigested food.

Remote Effects.—The preparations of zinc have been thought to exert an **antispasmodic** influence upon the nervous system, and the sulphate and oxide were formerly employed to a considerable extent in the treatment of such affections as epilepsy, chorea, hysteria and whooping-cough. Their efficacy is doubtful, however, and they have now largely fallen into disuse as nervous depressants. The oxide is of some service in checking the night-sweats of phthisis, particularly when combined with extract of belladonna, but it is quite likely to interfere with the digestion. Trousseau's pill for this purpose consists of zinc oxide, 0.30 gm. (5 gr.), with extract of hyoscyamus, 0.06 gm. (1 gr.).

Zinc phenolsulphonate and valerate are considered elsewhere (*see* pp. 312 and 646).

TOXICOLOGY

The appearances met with after death from zinc chloride are those which commonly characterize the action of a gastro-intestinal irritant. The sulphate, in large doses, also acts as an irritant poison, producing colicky pains, diarrhœa and prostration.

Treatment.—The salt itself usually produces such prompt and copious vomiting that other emetics are scarcely required, but these may be given if needed (*see* p. 380), or the stomach may be washed out. Demulcents should then be administered, such as lime-water, mucilaginous drinks, and albumin freely in the form of eggs or milk.

COPPER SULPHATE

For the Preparation of Copper Sulphate *see* p. 80.

Action of Copper Sulphate

External.—Used in substance, it is somewhat corrosive. In solution it acts like zinc sulphate, but is more strongly **astringent** and

antiseptic in the strength of 1 to 1000. Copper and its salts are destructive to nearly all the lower forms of plant life; very small traces, insufficient to injure man or the higher animals, being sufficient to free water from algæ.

Internal.—*Alimentary Canal.*—In moderate doses it is a prompt and efficient **emetic,** acting in precisely the same manner as zinc sulphate, though it is more irritant. In large quantities it causes corrosion of the gastro-intestinal mucous membrane, with violent vomiting and purging. In small doses it is markedly astringent.

Remote Effects.—Small amounts may be taken for an indefinite period without giving rise to any appreciable effect, so that the general action of copper salts in man is unknown. Copper is absorbed from the stomach and intestine, and also from other mucous membranes and from wounds, and the metal is stored chiefly in the liver, though it is found in smaller amounts in the spleen, kidney and thyroid. It is excreted in the intestinal secretions, bile, urine, saliva and milk, and is said to pass from the mother to the fœtus in utero. It is stated to have a strong affinity for hæmoglobin, forming with it a compound called cupro-hæmol, but, like zinc, does not increase the hæmoglobin of the blood. Animals have been fed with food containing considerable amounts of copper for many months at a time without showing any special evidence of poisoning, and this metal, it is said, is found so regularly in the tissues of man and animals that it may be regarded as a normal constituent, although its function is quite unknown and it may be merely stored up on its way to excretion.

Therapeutics of Copper Sulphate

External.—As a **caustic** it is milder in action and also less painful than silver nitrate. In solid form or powder it is applied to indolent ulcers and granulations, syphilitic and other sores in the mouth and throat, granular lids, corneal ulcers, etc. In weak aqueous solution it is sometimes employed in subacute conjunctivitis. In place of the sulphate, lapis divinus may be used as a caustic which consists of copper sulphate, potassium nitrate, and alum, each 24 parts, and camphor, 1 part; fused together, and the whole mass cast in cylindrical moulds. Lotions of copper sulphate are more strongly **astringent** than those made with zinc sulphate, but are often employed for the same purposes in the strength of about 1 to 240. In this strength

it may be instilled into the eye. Somewhat more concentrated solutions have a mild **hæmostatic** effect, and the solid salt is also serviceable for checking hæmorrhage from slight wounds, leech bites, and irritable ulcers.

Internal.—As an emetic it is used in the same class of patients as zinc sulphate. As it is more irritant than the latter, the stomach should be promptly and thoroughly evacuated by some other means when it fails to produce vomiting. On account of its irritant effect some would restrict its use as an emetic to instances of phosphorus poisoning, in which it has been supposed to be particularly serviceable on account of the possible deposition of copper on the particles of phosphorus preventing the absorption of the latter. Associated with opium, it is a useful palliative **astringent** in the diarrhœa of phthisis, and of all the metallic astringents in use, it has been pronounced the most effective in chronic diarrhœa and chronic dysentery. It is regarded as indicated when colic and tenesmus are present, and the stools, partly feculent, contain mucus streaked with blood. It has been used in anæmia and chlorosis, and has also been recommended in the treatment of syphilis. It has been recommended in 0.06 gm. (1 gr.) doses in the treatment of actinomycosis.

TOXICOLOGY

Acute Poisoning.—Copper is apt to give a blue or green tinge to the vomit and fæces, and later blood appears in them from the corrosion of the mucous membrane. There is intense abdominal pain, and the usual symptoms of acute corrosive poisoning may follow—collapse, with weak pulse and respiration, cold, clammy skin, dizziness, unconsciousness, delirium, complete coma, convulsions and paralysis.

Chronic Poisoning.—This is a matter of great practical interest. Preserved peas and other vegetables, the green color of which is due to preparation with copper, are in common use by the public. Copper is also added to flour to improve the bread made from it, and it may enter the food from the use of cooking utensils, made of this metal and in a variety of other ways. It is claimed, however, that copper may be taken directly, either in the form of the metal or of its soluble salts, for prolonged periods without the production of any symptoms except perhaps more or less nausea and the evidences of a mild intestinal catarrh. Among workers in copper and brass, the skin and hair not infrequently have a greenish tint, while the upper borders of the teeth may show a green discoloration which is known as the "copper line." In addition, colic and diarrhœa, or acute febrile attacks of gastro-intestinal catarrh, which may be followed by local paralysis, are sometimes observed, and the following symptoms have also been noted:

anæmia, wasting, dyspepsia, tremors, headache, vague pains, pharyngeal and laryngeal catarrh with occasional hæmoptysis and aphonia, and profuse secretion of sweat, which may be of a greenish hue. The occurrence of these various manifestations has been attributed in part to the deposit of copper dust upon the skin, hair and teeth, and in part to the lead, arsenic and other poisons often associated with copper. It would seem altogether probable that in a considerable proportion of instances such an explanation will suffice for the symptoms present, but, on the other hand, certain patients come under observation from time to time in which the evidences of chronic poisoning are indisputably due to copper alone.

Treatment.—For acute poisoning give albumin, milk or magnesia. Potassium ferrocyanide is the chemical antidote. Then promptly empty the stomach and saturate the organism with potassium iodide. Chronic poisoning is best treated by the administration of fifteen drops of dilute phosphoric acid before each meal, the ingestion of large quantities of milk, and thorough daily evacuation of the bowels with magnesium or sodium sulphate.

ALUMINUM

For the Preparations of Aluminum Salts *see* p. 82.

Action of Aluminum Salts

External.—Aluminum salts in solution are **astringent** and **hæmostatic,** throwing down a layer of precipitated albumin on the surface of mucous membranes and on raw surfaces; also coagulating the albumin in the underlying tissues, and thus constricting the blood-vessels. In concentrated form they act as irritants, and burnt alum, which is alum with its water of crystallization expelled by heat, by reason of its marked avidity for water, is somewhat **escharotic.** On account of this property of precipitating proteids aluminum salts are **antiseptic,** as well as astringent. In hæmorrhage, when the bleeding vessels can be directly reached, alum is a valuable hæmostatic, as it acts in three ways to arrest the bleeding: coagulating the albumin, constringing the parts, and, by crystallizing when applied in large amount on cotton, affording a surface which aids coagulation.

Internal. *Alimentary Tract.*—They have a purely local action, not being absorbed to any extent from the alimentary canal, and even large amounts causing only a local exudative inflammation, in consequence of the precipitation of proteids, which is characterized by nausea and vomiting and, in extreme instances, by purging. In small doses they act as **astringents** upon the mucous membrane of the

mouth, stomach and intestine, and usually cause constipation. In larger doses they are mechanical **emetics.** On account of the lack of absorption, no symptoms of general poisoning are induced by their internal administration, nor is their long-continued use ever attended with evidences of chronic poisoning.

Remote Effects.—The general action of aluminum salts is seen only when they enter directly into the circulation. Aluminum, like various other metals, acts on the intestine and kidney, and also appears to have a direct action on the brain. The intoxication is a very slow one, the symptoms appearing only several days after the intravenous injection, at a time when the metal has entirely disappeared from the blood, and has become fixed in the cells. In mammals the first symptoms are observed in from three to five days, and are found to consist in constipation, rapid loss of weight, weakness, torpor and vomiting. Later, marked abnormalities in movement and sensation are noticed, such as tremor, jerking movements, clonic convulsions, paresis of the hind legs, anæsthesia of the mouth and throat, and lessened sensation over all parts of the body. Eventually diarrhœa and albuminuria are generally noted. After death there are found swelling and congestion of the gastro-intestinal mucous membrane, fatty degeneration of the liver and kidney, and hæmorrhages in the cortex of the latter organ; while aluminum is found in the urine. It has recently been shown that the nerve cells of the spinal cord and medulla oblongata, and particularly those of the lower cranial nerves, undergo degeneration. What little aluminum is absorbed from the alum salts in the food is thought to be rapidly excreted by the intestine and by the kidney.

Therapeutics of Aluminum Salts

External.—Alum is in general use as a **local astringent.** Thus, solutions of it are used as injections in leucorrhœa, gonorrhœa, gleet, and dissolved in infusion of kino (1 to 20) it is an efficient application for prolapse of the rectum in children. Burow's solution (*see* p. 516) is slightly astringent and moderately antiseptic and is frequently used as a wet dressing for infected wounds. Alum in powder or strong solution is serviceable as a styptic for capillary hæmorrhage from wounds, hæmorrhage after tooth-extraction, leech bites, epistaxis, bleeding from the gums, bleeding piles, etc. The topical application of powdered alum is sometimes very useful in chronic pharyngitis,

tonsillitis and nasal catarrh. A 1 per cent. solution in water is employed as a gargle, and gargling the throat with alum dissolved in a decoction of barley, to which a small quantity of honey of rose is added, is of service to speakers or singers if practised shortly before using the voice. Alum has been used in solution as a mouth wash for ulcerative stomatitis and mercurial ptyalism, but is objectionable for this purpose, as well as for making gargles, as it attacks the enamel of the teeth. The local astringent action of alum may be utilized for moist eczema and purpura, and, dissolved in water to which alcohol is added, it may be sponged over the surface for night-sweats or excessive sweating of the feet or hands. Alum solutions are also more or less effective in the treatment of bed-sores, and chilblains. A hot solution will sometimes relieve pruritus vulvæ, and ointments containing alum are often useful in herpes and bromidrosis. The powder is occasionally applied as an escharotic for destroying granulations and warty growths and is also used to stimulate indolent ulcers.

Internal.—Since it is not depressing, alum is a good emetic, especially for children suffering from croup, bronchitis, etc. In intestinal hæmorrhage when dependent upon mechanical causes, such as cirrhosis, if the mucous membrane is free from acute inflammation, and in hæmatemesis when this is passive and the mucous membrane relaxed, alum is likely to be of service. Alum is one of the most effective of all remedies in the treatment of **lead colic,** and by many it is considered to relieve the pain and nausea and overcome the constipation of plumbism more certainly than any other agent. Its beneficial action is attributed by some to the fact that, being a sulphate, it precipitates any lead salts present in the intestine as insoluble lead sulphates, and because it is a soluble sulphate, as well as an emetic, alum may be used as an antidote in acute lead poisoning.

3. Emollients and Demulcents.

STEARIC ACID

For the Preparations of Stearic Acid *see* p. 257.

Action and Therapeutics of Stearic Acid

Stearic acid has no known general action upon man.

It is used chiefly in the manufacture of glycerin and other sup-

positories. The zinc salt has been employed in various diseases of the skin for which an **emollient** application is desirable.

WOOL FAT

For the Preparations of Wool Fat *see* p. 248.

Action and Therapeutics of Wool Fat

Hydrous wool fat is **soothing** to the skin, and when rubbed in is more quickly absorbed than most fats. Since it will absorb more than its weight of water, it is an excellent base for ointments of substances that require an aqueous solution.

In ichthyosis and scleroderma and in senile atrophy of the integument it softens the surface, and inunction with it aids in obliterating wrinkles. It is a serviceable application for chapped hands and lips, frost-bite, erythema, impetigo contagiosa, dermatitis, and acute eczema, and is efficient in allaying the itching of exanthematous diseases. In chronic eczema with infiltration and in psoriasis it assists the action of remedies which may be combined with it. It is a useful vehicle for remedies to be used by inunction, and on account of its **penetrative** power, as well as its ready **miscibility** with mercury, it is of peculiar value in the inunction treatment of syphilis. It is employed as a vehicle for cocaine in affections of the nose, and for cocaine, morphine, atropine and other anodyne remedies in neuralgias.

LARD

For the Preparations of Lard *see* p. 247.

Action and Therapeutics of Lard

Lard is one of the best emollients, its application to the skin being followed by a pleasant **feeling of softness** Melting at the temperature of the body, it is readily absorbed by the integument. The benzoinated lard has the advantage of not quickly becoming rancid, but it is sometimes irritating to tender skins.

When the secretory action of the skin is impaired, inunction with lard serves as a partial substitute, and benzoinated lard is sometimes employed in massage. It is also of service in chest affections.

On account of its **penetrating** power, active agents, such as mercury and the alkaloids, can be combined with lard for administration by inunction. Its chief use in medicine, however, is as a basis for ointments.

SPERMACETI

For the Preparation of Spermaceti *see* p. 248.

Action and Therapeutics of Spermaceti

Spermaceti is **emollient** and is a constituent of the eligible ointments used for that purpose.

In the form of powder, which may be obtained by triturating it with a little alcohol, spermaceti is sometimes employed as a **dusting powder** for the feet, for the purpose of preventing friction.

PETROLATUM

For the Preparations of Petrolatum *see* p. 48.

Action and Therapeutics of Petrolatum

Petrolatum is emollient, without odor or taste, and for that reason is acceptable to mucous membranes; it has no nutritive properties.

This substance is used principally as a bland, **neutral protective,** and, because it does not become rancid nor act as an irritant, and as it is not affected by acids, alkalies or powerful reducing agents it is employed as a substitute for fatty materials in ointments. But as it penetrates the skin with difficulty it is not a suitable vehicle for drugs which are intended for absorption. Liquid petrolatum has been used as a local soothing application in inflammation of the mucous membrane of the nose, throat, larynx, and even of the bronchial tubes, by means of an atomizer either alone or as a vehicle for various medicinal substances. Although liquid petrolatum retards the emptying of the stomach and to a limited extent interferes with intestinal digestion, it has come into extended use in the treatment of **intestinal stasis.** Under its use auto-intoxication from the alimentary tract is diminished, it lubricates the intestinal

canal, softens the fæces, and also increases the bulk of the intestinal contents. The pharmacopœial dose of 15 mils (4 fl. dr.) may often be exceeded with benefit and the entire daily amount be taken as one dose at bedtime.

COTTON

For the Preparations of Cotton *see* p. 243.

Action and Therapeutics of Cotton

Cotton is used in various forms as a covering or protection, and when medicated, for the topical application of remedies. The only use of soluble gum cotton (pyroxylin) is for making collodion, which, when painted on the skin, quickly forms a thin and dry protective film over it, in consequence of the evaporation of the ether. Flexible collodion has the advantage, over the ordinary, of not cracking. These preparations are **protective** to small wounds and surfaces, and are used after slight operations. The edges of larger wounds may be drawn together and kept in position by strips of gauze, which are made to adhere to the skin by the application of several coats of flexible collodion. Collodion is especially serviceable for scalp-wounds, in which it often renders a bandage unnecessary. The contraction resulting from the drying of collodion is sometimes utilized in the abortive treatment of boils, and of the papules of small-pox, to prevent pitting, and as well as in the treatment of epididymitis, in which the scrotum is freely painted over with it. Collodion may also be applied in superficial burns, in erysipelas, and in herpes zoster. Cottonseed oil (*see* p. 224) is used simply as a bland, nutritious oil, and, for its emollient properties, in liniments.

OIL OF THEOBROMA

For the Preparation of Oil of Theobroma *see* p. 243.

Action and Therapeutics of Oil of Theobroma

Oil of theobroma is a **nutrient** of pleasant taste, and an **emollient** which does not readily become rancid.

It is used to make suppositories, and also by inunction to improve the general nutrition, especially in children.

LINSEED

For the Preparations of Linseed *see* p. 230.

Action and Therapeutics of Linseed

Linseed is both **demulcent** and **emollient.** It is mildly diuretic, due to the excretion by the kidneys of the resinous oxidation products formed from the oil, and its preparations, if given in sufficient amount have a laxative effect.

Externally linseed, in the form of poultices, is used for the purpose of applying warmth and moisture, especially in inflammatory conditions, both superficial and deep-seated. It relaxes the tissues and relieves pain. It tends to check inflammation if applied early, and accelerates the evacuation of pus after suppuration has commenced, but, as ordinarily used, however, is surgically unclean. Linseed and other poultices not only promote local **vascular dilatation,** but also have a counter-irritant effect, increased, if desired, by the addition of mustard or by smearing the surface to be covered with equal parts of fluid extract of belladonna and glycerin, or with a few drops of turpentine. Linseed oil, with an equal part of lime water, which is known as Carron oil, was long a favorite remedy for burns, but as it is uncleanly, it has been supplanted by other agents. The oil is also sometimes used for **laxative** purposes as an enema, especially in children. Linseed tea (linseed, 3; licorice, 1; boiling water, 100) is a common domestic demulcent, which if given hot, has a diaphoretic effect, and the large amount of mucilage which the linseed contains renders it very soothing to the inflamed bronchial mucous membrane.

OLIVE OIL

For the Preparations of Olive Oil *see* p. 223.

Action of Olive Oil

Olive oil is emollient, demulcent, nutritive and mildly laxative. Externally applied it acts as a **protective** to the skin, which it renders

soft and pliable; with sufficient friction it is absorbed and assimilated by the system. Taken by the mouth, it is partly emulsified and partly saponified in the intestine, and the olein it contains is finally deposited in the body as fat. If the quantity ingested is larger than can be absorbed, the excess will appear unchanged in the urine.

Therapeutics of Olive Oil

External.—It is sometimes employed in massage, but hydrous wool fat is better for this purpose. Warm olive oil is useful for removing crusts in such conditions as seborrhœa, eczema and psoriasis. It should not be allowed to get into the eyes, as it is liable to produce considerable irritation. It is a common **soothing** protective in burns and acute inflammatory affections of the skin, coating the surface and excluding the air. In the former it is sometimes used in place of linseed oil in lime liniment (*see* p. 71). As it is absorbed by the lymphatics when rubbed vigorously into the skin, it may be used in this way for the purposes of a **food**, in instances where sufficient nourishment cannot be taken by the mouth; however, it is less valuable than cod liver oil. Oil inunctions are of great service in scarlet fever and other exanthematous diseases, reducing temperature, allaying the burning heat and itching of the skin, and in this way diminishing restlessness. Their antipyretic effect is also probably due to a considerable extent to their influence in mitigating one of the chief sources of distress in this class of affections. They are especially valuable in the desquamative stage of scarlet fever, where they serve a prophylactic purpose by preventing the dispersion of the scales. By dropping a little olive oil into the auditory canal, insects can readily be removed from the ear. It is employed as an ingredient in many liniments, plasters, ointments and cerates, but owing to frequent adulteration cottonseed oil is now generally substituted.

Internal.—From ancient times it has been an article of diet in olive-growing lands, but, except as an ingredient of salad-dressings, it is not much used as a food in this country. It has been employed as a demulcent to check an excessive secretion of hydrochloric acid in the stomach, especially where this has resulted in an ulcer. Taken promptly into the stomach in sufficient quantity, it is useful in mitigating the effects of irritating poisons, but it should not be

employed after phosphorus has been swallowed, as the latter dissolves in it. As a **laxative** it is much used, in teaspoonful doses, for infants. On account of its blandness it is frequently prescribed in the form of an enema, which may be composed entirely of warmed olive oil or of oil and warm mucilage of starch, or of soap and warm water. The latter is most generally employed for ordinary purposes because water softens fæces more thoroughly than olive oil. It has been found very useful in keeping the bowels of workmen employed in white-lead factories free, and preventing the absorption of the metal, and it is also efficient in the treatment of lead colic itself. There is some clinical evidence of the value of olive oil in **biliary calculi**; 250 mils (8 fl. oz.) should be taken daily. After these doses continued for a considerable period of time, masses of soap, formed by the intestine, have been found in the fæces, which being mistaken for gall-stones, have doubtless been responsible for the greater part of the reputation which olive oil has enjoyed as a solvent. While outside the body the oil is a solvent for cholesterin, the chief constituent of gall-stones, it has been doubted if it is possible for the oil to exert this solvent action, but there can be no question that it is of service in **cholelithiasis** by increasing the watery secretion of bile.

SESAME OIL

For the Preparations of Sesame Oil *see* p. 225.

Action and Therapeutics of Sesame Oil

This oil does not become rancid on exposure to the air, and possesses **emollient** and, in large doses, **laxative** properties.

It has been used for centuries for the same purposes as olive oil although the taste is not so agreeable nor is it believed to be equally digestible. It has been used as a demulcent in various irritative intestinal conditions.

OLEIC ACID

For the Preparations of Oleic Acid *see* p. 223.

Action and Therapeutics of Oleic Acid

Oleic acid is **unirritating**, and penetrates the skin readily.

It is not employed by itself in medicine, but is used pharmaceutically

in the preparation of **oleates** and also in plasters and soaps. Oleates are made from the alkaloids, not from their salts; if metals are employed, the oxides only are chosen. Many substances which are either not absorbed at all or only to a very limited extent from aqueous solutions, are freely absorbed from oily ones, while some which are not soluble in oils dissolve in oleic acid. Hence the special utility of the oleates, of which only the oleate of mercury is official; the others are prescribed extemporaneously.

SOAP

For the Preparations of Soap *see* p. 224.

Action of Soap

Externally soap is **detergent,** combining with the fat of the excretions and removing, along with this, epithelial scales, bacteria and other foreign matters. It may set up considerable irritation if applied too long or with much friction, or if the soap used is strongly alkaline or not sufficiently diluted with water. Internally it is **laxative** and antacid.

Therapeutics of Soap

Hard soap, in powder, is used to some extent as an ingredient of dentifrices, and it no doubt aids in the cleansing and preservation of the teeth. In recent years it has been considerably employed for soaps, medicated with sulphur, tar, phenol, mercury bichloride, ichthyol, eucalyptol, naphthol or salicylic acid, which, if judiciously applied, are decidedly beneficial in a variety of cutaneous affections. Hard soap is a good excipient for pills, and it forms the basis of several of those in the Pharmacopœia. Soap, dissolved in water (1 to 4), is of considerable value as an **antidote in poisoning by acids** and other irritants. It also acts as an aid to emetics, and has the great advantage of being always accessible. Its use should be resorted to at the earliest possible moment and continued until more powerful alkalies, such as chalk, magnesia, or sodium bicarbonate, can be obtained. The liniment is a cutaneous stimulant, when employed with friction in sprains, stiffness of the joints or muscles, etc. It is also a favorite basis for extemporaneous pre-

scriptions, and such agents as aconite, opium or belladonna are frequently combined with it.

Soft soap, which is also known as green soap, although it is generally yellowish-white to brownish-yellow, is much more strongly alkaline than hard, and, containing free potassium hydroxide, is decidedly **irritant.** It has a softening effect on tissues with which it comes in contact, and one of its uses is to remove crusts and epithelial scales in cutaneous affections. The liniment is an excellent cleansing agent for the scalp, especially in seborrhœa, but for shampooing purposes it should be diluted with three parts of Cologne water. When pediculi are present it is useful in preparing the way for a parasiticide application by dissolving the adhesion of the nits to the hair shafts. This is also employed as an application, usually enforced by more energetic medicinal agents, for sprains, stiff joints, etc. One of the most common uses of both hard and soft soap is for **purgative enemata;** but the latter is decidedly preferable, with water at a temperature of 37.8°C. (100°F.). Soap enemata, especially if made from the hard variety, are somewhat liable to give rise to an erythematous or urticarial eruption, and this, in some individuals, makes its appearance regularly after each injection, however often repeated. In order to increase the efficiency of a soap enema it may be advisable to add castor oil to it.

MALT

For the Preparations of Malt *see* p. 232.

Action of Malt

Malt is **demulcent** and **nutritive.** It is often used to conceal the taste of nauseous medicaments as cod liver oil or fluidextract of cascara sagrada. Many of the manufactured extracts of malt are quite inert as regards the digestion of starch, inasmuch as the diastase of the malt has been destroyed by the heat used during their preparation; but, even thus devoid of digestive power, they form a pleasant, easily digested food. Alcohol, as well as heat, destroys the ferment, and the liquid malts containing alcohol are also worthless for assisting starch digestion. Many are only beers of an inferior quality, and the best of them are indistinguishable from stout. As malt

liquors contain malt extract, as well as hops, an aromatic bitter, their nutritive, tonic and stomachic qualities are greater than those of spirits or wine. At the same time, it must not be forgotten that the beneficial effects of these constituents are to a very considerable extent diminished by the process of fermentation; so that the value of such beverages as foods is apt to be greatly exaggerated. They increase the appetite and lead to the deposition of fat, and when taken in excess are not infrequently the cause of fatty degeneration in various organs, more particularly the liver and the heart.

Therapeutics of Malt

Malt extracts, the value of which depends principally on the amount of maltose they contain, are used in all conditions where it is desirable to give a readily **assimilable carbohydrate food.** They are particularly indicated in convalescence from acute disorders, in the debility caused by chronic disease, and in malnutrition from poor digestion and assimilation. They are usually well borne by the stomach, and in many instances can be taken by those who reject other nutritive agents, such as cod liver oil. While not possessing all the virtues of the latter in pulmonary tuberculosis, they sometimes prove a satisfactory substitute for it. Not infrequently malt is combined, in emulsion, with cod liver oil; the comparatively small dose of the latter then required being less apt to disagree with the patient than a larger quantity taken by itself. Malt extract, to which a suitable amount of fluidextract of cascara sagrada has been added, is an excellent laxative.

SUGAR

For the Preparations of Sugar *see* p. 231.

Action and Therapeutics of Sugar

Sugar is **nutrient, demulcent,** antiputrefactive but not antifermentative. While essentially a food, it contains no nitrogen, and is therefore capable of sustaining life by itself; in the system, however, it develops adipose tissue and acts as a respiratory fuel. In the healthy individual, sugar and sugar-forming food, it is estimated,

constitute more than one-half of the nourishment required by the body. It also has some diuretic action.

It is used as a sweetening and preservative agent, especially in the form of syrup. Sugar is the principal basis of troches, pastilles, and various other sweet preparations. Mixed with iron preparations, it is a protective against oxidation. When take in moderation sugar tends to **promote digestion**, and sweetened water (*eau sucrée*) is very extensively used in France and other parts of Europe. In catarrhal affections of the air-passages sugar has a soothing effect upon the mucous membrane. Sugar is contra-indicated in diabetes mellitus, obesity, and conditions involving fermentative changes in the stomach or intestines.

GLUCOSE

For the Preparations of Glucose *see* p. 232.

Action and Therapeutics of Glucose

The action of glucose is similar to that of sugar, namely **nutrien**- but it is directly fermentable and less sweet. It is readily digestible and has nearly the same food value as sugar.

It is of considerable interest physiologically but has little use in therapeutics. It has been employed as a **diuretic** in daily doses of 180 mils (6 fl. oz.) in the treatment of dropsical effusion but should be avoided if renal changes are marked. It is said to be protective against the fatty degenerations resulting from chloroform, ether and alcohol and has been proposed in 2 per cent. solution as an intravenous injection to combat shock. It may also be used in 10, or more, per cent. solutions for **nutritive enemata.**

GLYCYRRHIZA

For the Preparations of Glycyrrhiza *see* p. 229.

Action and Therapeutics of Glycyrrhiza

Glycyrrhiza is demulcent, **expectorant** and laxative. Locally it has a slightly stimulating action, and it increases the flow of saliva and, when slowly ingested, favors the expulsion of mucus.

In pharyngitis and bronchitis, it is an excellent demulcent.

The pure extract is a popular remedy for hoarseness, and the compound mixture is much used as an expectorant. It is largely employed to conceal the taste of disagreeable medicines and as a basis for pills; for these the root is commonly used as a dusting-powder and coating. The compound glycyrrhiza powder is a pleasant and efficient **laxative**, and is especially well adapted for children and pregnant women. When necessary, it may be combined with an equal quantity of compound jalap powder. The demulcent properties of glycyrrhiza render it serviceable in irritable conditions of the mucous membrane of the bladder and intestines, as well as of the air-passages. Ammoniated glycyrrhizin possesses no advantage over the extract, and is devoid of the demulcent properties of the drug.

ELM

For the Preparations of Elm *see* p. 228.

Action and Therapeutics of Elm

Elm is **demulcent** and in some degree nutritive, as well as slightly astringent.

It is often employed to make **poultices**, especially for use upon children, because it is lighter than flaxseed. These, with lead water, are serviceable in erysipelas and various forms of local inflammation, applied either hot or cold. When chewed it moistens the mouth and throat, and employed in this way it is soothing in irritable conditions of the faucial and bronchial mucous membrane.

ACACIA

For the Preparations of Acacia *see* p. 228.

Action and Therapeutics of Acacia

Acacia is a valuable **demulcent**, but appears to have little nutrient value though it may possibly retard tissue-waste. One of the chief uses of acacia is to emulsify oils and resins (*see* p. 26), and to give increased viscosity to mixtures containing heavy and insoluble powders.

On account of its demulcent properties, it is employed at times in

inflammatory conditions of mucous membranes. As a **protective** to the inflamed surfaces in pharyngitis, laryngitis, etc., it is commonly used in the form of troches, with which astringents or other agents may be incorporated. A snuff composed of powdered acacia and bismuth subnitrate, to which a little morphine may be added, is often useful in checking coryza.

TRAGACANTH

For the Preparations of Tragacanth *see* p. 227.

Action and Therapeutics of Tragacanth

Tragacanth is **demulcent** and slightly nutritive, but if given in large quantity is apt to cause indigestion.

Its chief use is to suspend insoluble powders, for which it is better than acacia, because it does not readily ferment. It is sometimes used as a **vehicle** for medicinal agents in gargles, and is a constituent of most of the official troches. It may be employed as a demulcent in pharyngitis, gastritis and intestinal inflammation. On account of its greater tenacity, mucilage of tragacanth is preferable to that of acacia as an external protective.

ALMOND

For the Preparations of Almond *see* p. 148.

Action and Therapeutics of Almond

The sweet almond is demulcent and nutritive; the bitter, which is no longer official, differs from it in containing amygdalin and is poisonous in large quantities.

The emulsion is an **emollient** liquid which may prove of service in irritations of the pharynx and air-passages, as well as of the stomach and intestines. It is also a pleasant vehicle for other remedies in various conditions, and is especially useful for insoluble drugs. The expressed oil of almond might be used for the same purposes as olive oil, but is more expensive; to most persons it is much more palatable. It is, however, used to a considerable extent in ointments, and is especially useful as an application to the hair. It is serviceable for excoriations and inflammatory affections of the skin, and also, when

heated, as a local application in earache. Internally it may be used as a **laxative.** One of the most important medicinal uses of the sweet almond is in the form of bread made from its flour. It contains practically no starch, and being palatable and nutritious, has proved very satisfactory in the diet of diabetics. Almond meal is sometimes used instead of soap for the toilet, rendering the skin soft and smooth. Almond emulsion, combined with bismuth subnitrate and thymol iodide, may be used locally for the removal of sunburn, freckles and skin pigmentations. With mercury bichloride it is recommended in acne rosacea. Benzaldehyde (*see* p. 149) produced synthetically, or obtained from the oil of bitter almond, is employed for the same purpose as the oil.

GLYCERIN

For the Preparations of Glycerin *see* p. 226.

Action of Glycerin

External.—Glycerin is powerfully **hygroscopic.** Applied to the cutaneous surface, it is somewhat **irritant,** and even when diluted causes a temporary smarting on abrasions, attributable to its great avidity for water which it tends to abstract from the tissues. The pain quickly subsides, however, and it then acts as a protective to the parts, and is **emollient** to the skin and **demulcent** to the mucous membranes. When injected into the rectum, however, it causes, by its irritant action upon the anal canal, evacuation of the bowels.

Internal.—Notwithstanding the fact that in animals it destroys life in a few hours, in man very large doses of glycerin, taken by the mouth, ordinarily produce only a mild gastro-intestinal irritation. Glycerin is rapidly absorbed from the intestine and undergoes oxidation in the tissues; only a very small fraction of it appearing in the urine. Like alcohol, which is also readily absorbed, it therefore acts in some sense as a food, and serves to increase the total energy of the body. Glycerin tends to increase the non-nitrogenous, and not the nitrogenous reserve of the body, its combustion saving a certain amount of the fat from being destroyed; therefore, it is of secondary importance as a food, although, like alcohol, it may be of value in certain conditions. As in the latter, it is still practically undecided

how far it leads to an economy of the nitrogenous tissues, as the fats and carbohydrates do. Internally, as well as externally, glycerin is a good demulcent, but, since it is so quickly absorbed, its action does not extend beyond the stomach. In some forms of experimental glycosuria glycerin appears to reduce the amount of sugar present, and it is believed that it probably has some effect on the sugar formation in the tissues, although no satisfactory explanation of its action in this particular has as yet been given. It has a decided value as an **antiseptic,** and this is probably due to its hygroscopic properties. It is destructive to parasites, both intestinal and external.

Therapeutics of Glycerin

External.—Glycerin is employed to a greater extent externally than as an internal remedy. It is an extremely useful emollient, and as it does not evaporate or turn rancid, and is **readily absorbed** when rubbed into the skin, it has many advantages as a vehicle for the application of active medicinal agents. Glycerin, diluted one-half with distilled water, is of great service in relieving the dryness of the lips, mouth and tongue in fevers. A mixture of glycerin, crystallized sugar, and whiskey, which is allowed to trickle down the throat, may also be given for the same purpose. Among the many other useful applications of glycerin are the following: For chapped face and hands, sore nipples, and piles it may be combined with rose water; for excoriations, erythema, and superficial burns, with lime water; for erythematous or vesicular eczema, burns, and seborrhœa, especially about the axilla and the genital organs, with phenol and either bismuth subnitrate or sodium bicarbonate; for freckles and other skin pigmentations with lactic acid, and for pruritus, eczema and urticaria with menthol. The latter combination with eucalyptol, may also be used, in the form of a spray, in nasal catarrh, pharyngitis and laryngitis. The glycerite of tannin makes an excellent astringent application for chronic follicular pharyngitis, relaxed mucous membranes, and other conditions. The glycerite of starch is frequently employed as a vehicle for the application of astringents to the eye, and glycerin and its preparations are also much used in ear affections. Glycerin is a convenient vehicle for promoting the absorption of various drugs by the skin. Glycerin, either alone or combined with an astringent or sedative, may be employed for the

prevention of bed-sores. Glycerin, as well as boroglycerin (*see* p. 321), is used extensively in various local applications in the treatment of diseases of women, and in congested states of the genital organs it is of special service by causing, on account of its affinity with water, an abundant serous transudation.

Internal.—On account of its sweetness glycerin is employed to a considerable extent as a **flavoring agent.** Large doses sometimes cause purgation, but it is not a reliable remedy for this purpose, and alone is seldom given by the mouth as a laxative, except perhaps for hæmorrhoids, upon which it is asserted to have a peculiarly soothing effect. To produce efficient cathartic action it is necessary that it should be combined with magnesium sulphate or carbonate, and tincture of rhubarb and of belladonna. As a laxative, however, it is much more frequently administered by the rectum, where 8 mils (2 fl. dr.) produces a prompt evacuation, without pain or other disturbance; the most convenient way to use it is in the form of a suppository. The glycerin is said to pass upwards as far as the sigmoid flexure, and even beyond. While from contact it may perhaps increase the peristalsis of the large intestine, the local irritation of the anal canal is itself no doubt sufficient to set up reflex movement of the bowel. Glycerin has been advised by some as a food in conditions of malnutrition, but, it is an inferior substitute for cod liver oil and other fatty substances. It was formerly used to a considerable extent by diabetics as a substitute for sugar as a sweetening agent but its sweetness is of a rather disagreeable kind and its place has now largely been taken by saccharin. Glycerin, it has been found, is capable of destroying trichinæ in the intestinal tract, and it is therefore a remedy of distinct value in patients suffering from **trichiniasis.** Among other conditions in which it has been used internally may be mentioned vomiting of pregnancy, gallstone disease, and nephrolithiasis.

CHONDRUS

For the Preparations of Chondrus *see* p. 225.

Action and Therapeutics of Chondrus

Chondrus is **demulcent** and somewhat **nutrient,** though the gum which enters largely into its composition is not readily digestible.

The decoction, which is not official, was formerly much used in bronchial affections, diarrhœa, dysentery and irritation or inflammation of the genito-urinary tract. Whatever beneficial effect it may have had was probably due to its protective qualities, and also possibly, to some extent, to the influence on nutrition of the minute quantity of iodine in it. When made into a jelly it is a pleasant article of diet, but it is really of not marked nutritive value.

AGAR

For the Preparations of Agar *see* p. 225.

Action of Agar

Agar is a **demulcent,** which can absorb water and soften to a jelly-like mass. It is not absorbed from the alimentary tract and for that reason should not be considered to be a food.

Therapeutics of Agar

It has enjoyed an extensive reputation as a remedy for **constipation** on account of its softening the fæces and increasing the amount of contents of the intestine. It may be administered in small fragments and given with stewed apples or mashed potatoes or by cooking it in water until it forms a thin jelly which, however, is very difficult of administration an account of its adhesive properties. On account of its being itself readily decomposed and of its being a good culture medium, mechanically retarding absorption in the intestine and from its demulcent properties, lessening irritation in the intestine, although its bulk will prevent diminished peristalsis, it has been the rule to administer with it some remedy of acknowledged purgative properties as cascara sagrada. Administered in this way it is efficient in overcoming intestinal stasis and diminishing autointoxication.

ALTHÆA

For the Preparations of Althæa *see* p. 227.

Action and Therapeutics of Althæa

Althæa is **demulcent,** emollient and slightly nutritious.

It is a useful demulcent for irritation of mucous membranes, espe-

cially as a remedy for pharyngitis. An excellent emollient poultice is made from the powdered root, and, combined with benzoinated lard, it is employed as a **bland dressing** in cutaneous affections. It is a constituent of blue mass and used in pills of ferrous carbonate and of phosphorus, to which it serves to give the proper consistence.

GELATIN

For the Preparations of Gelatin *see* p. 250.

Action and Therapeutics of Gelatin

Gelatin is a demulcent and styptic, and is also believed to be, to a considerable extent, **nutrient,** in the same direction, though not to the same degree, as albumin.

It is used as a basis for capsules, lozenges, and suppositories, as a coating for pills, and as a protective covering in certain diseases of the skin. Although it is a proteid which can be used as a food, indol cannot be formed from it and for that reason it can be employed in that form of intestinal putrefaction in which **indicanuria** is marked. Sterilized gelatin in a 1 per cent. solution has been administered by hypodermatoclysis or intravenously, to the amount of 100 mils (3 fl. oz.) to increase the coagulability of the blood in hæmorrhage or aneurism. As an antidote, gelatin is of especial value against poisoning by iodine, bromine and the alums, but requires much time for its preparation, since for this purpose it should be broken up and reduced to the consistency of honey by being soaked for half an hour in water.

STARCH

For the Preparations of Starch *see* p. 233.

Action and Therapeutics of Starch

Starch is demulcent and nutritive, and an important member of the non-nitrogenous group of alimentary principles known as carbohydrates, which are mainly concerned in **heat-production.** The excessive consumption of starchy food delays tissue-metamorphosis, causes a redundancy of fat, and often gives rise to acidity and flatu-

lence. Undigested starch passes into the fæces, and the urine may become saccharine.

Medicinally starch is inert, and it is used principally on account of its mechanical properties, which make it a good basis for dusting powders and insufflations, and to keep pills from adhering to each other. The glycerite is **emollient,** and is also employed as a basis for suppositories. Injections of starch water are soothing in irritative conditions of the lower bowel. The starch must be hydrolyzed by boiling about 4 gm. (1 dr.) with 60 mils (2 fl. oz.) of water, until it forms a clear paste and then diluting it with water to 500 mils (1 pt.). Starch is employed as an antidote in poisoning by iodine or bromine.

SUGAR OF MILK

For the Preparations of Sugar of Milk *see* p. 250.

Action and Therapeutics of Sugar of Milk

Being very hard, and also but slightly deliquescent, it is a valuable **excipient** for powders requiring the minute subdivision of their medicinal constituent and as a diluent to bring extracts to the required strength. It has been used as a carbohydrate food in phthisis and other wasting diseases, and, on account of its lesser liability to ferment, is preferred to cane-sugar for infant's food. It is also a **serviceable food** in acute febrile diseases, especially typhoid fever, and, being tasteless and easily soluble it may often be taken with advantage to the extent to 60 gm. (2 oz.) or more each day. It is a diuretic which may be employed in cardiac dropsy; but its action is slight when extensive renal disease exists.

DIVISION V.—DRUGS ACTING ON THE SKIN

While the drugs described in the preceding Division act on the cutaneous blood-vessels, in addition we have—

A. Diaphoretics, drugs which increase the amount of perspiration. These may do this: (1) By affecting the circulation in the skin. This may be locally (by local irritation) or systemically. In the latter, the action may be an indirect one, and due to a rise of

general blood-pressure if the cutaneous vessels are not at the same time constricted, or a direct one, due either to stimulation, direct or reflex, of the central dilator mechanism of the cutaneous vessels, or to paralysis of the vaso-constrictor mechanism of these vessels. (2) By directly augmenting the secretory activity of the cells of the sweat glands, either through stimulation, direct or reflex, of the sweat centers in the spinal cord, or through peripheral stimulation of the terminations of the nerves in the glandular cells themselves. As it is difficult to decide whether drugs acting on the vessels do not affect the other parts of the mechanism, and also whether a drug acts on the gland-cells or on the nerve endings, diaphoretics will be considered under two headings only: (*a*) those acting peripherally, and (*b*) those acting centrally. These are differentiated by observing whether the drug acts on a part of the skin after division of the nerves going to it, or whether it acts after destruction of the spinal cord.

(*a*) *Diaphoretics acting peripherally:* **Pilocarpine** greatly increases the amount of sweat, acting on the nerve terminations in the gland-cells, but not on the vessels. The same is true of local applications of **warmth.** **Alcohol** taken internally perhaps acts in the same way in addition to its action on its vessels.

(*b*) *Diaphoretics acting centrally:*

(1) **Antimony salts.**
(2) **Ammonium acetate.**
(3) **Ammonium citrate.**
(4) **Ipecac.**
(5) **Opium.**

(*c*) *Diaphoretics whose mode of action is doubtful:* Potassium citrate and acetate, senega, cubeb, colchicum, lobelia, arnica and aconite. All these, except the first two, are very feeble diaphoretics.

When a diaphoretic acts very powerfully it is called a **Sudorific.**

B. Anhidrotics, or **Antihidrotics,** drugs which diminish the amount of perspiration. The part on which these act is determined in the same way as with diaphoretics.

(*a*) *Anhidrotics acting peripherally:* **Atropine** is very powerful; it acts on the termination of the nerves in the glands, and **hyoscyamus** and **stramonium** apparently act in the same way. **Cold,** locally applied, has a similar action.

(*b*) *Anhidrotics the mode of action of which is doubtful:*

(1) **Acids.**
(2) **Nux vomica.**
(3) **Quinine.**
(4) **Zinc salts.**
(5) **Salicylic acid.**

Therapeutics.—Diaphoretics are used for the following purposes: (1) To remove fluid from the body, by causing the absorption of

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exudates. (2) To relieve diseased and overtaxed kidneys; for this purpose pilocarpine is much used. (3) To remove poisons introduced from without or formed in the body. Pilocarpine is also used to promote excretion by the sweat in uræmia and similar conditions. (4) To re-establish disturbed circulation in the skin, in order to relieve internal congestions, break up an incipient "cold," bring out the rash in exanthemata, promote defective nutrition of the skin in certain cutaneous diseases, etc. The increased vascularity of the skin is also made use of to facilitate the absorption of local medicaments, such as ointments. Diaphoretics act as mild antipyretics. (5) To increase the alkalinity of the tissues, as in gout, oxybutyric acid coma in diabetes, and acidosis. For this purpose drugs which directly stimulate the glandular activity are required, as the sweat is acid only when produced in this manner. It has been shown that an injection of pilocarpine is so effective in removing acid that it will render the urine of a healthy person markedly alkaline. In general, the sweat which results from increased circulation contains less solid matters and is more alkaline, while that resulting from direct action on the glands is more concentrated and less alkaline. This is the character of the cold sweat which carbon dioxide produces by stimulating the sweat centers, and which is often of serious import in the course of a disease, as indicating asphyxia. Certain drugs when taken internally are excreted in the sweat. Among them may be mentioned iodine, iodides, tartaric and benzoic acids, the latter in the form of hippuric acid.

Anhidrotics are employed to a limited extent either for general conditions, as phthisis, or for local conditions, as hyperidrosis of the hands or feet. Little or nothing is known of the effect of drugs on the sebaceous secretion, though the iodides and some other substances are excreted in it.

Certain drugs, when taken internally in large doses, **produce a rash** on the skin, possibly because in the course of their excretion through the skin they irritate it. Such are—

(1) **Copaiba.**
(2) **Cubeb.**
(3) **Bromides.**
(4) **Iodides.**
(5) **Turpentine.**
(6) **Belladonna.**
(7) **Hydrated chloral.**
(8) **Opium.**
(9) **Quinine.**
(10) **Salicylic acid.**
(11) **Arsenical salts.**
(12) **Acetanilid.**
(13) **Antipyrine.**
(14) **Acetphenetidin.**
(15) **Antitoxins.**
(16) **Serums.**
(17) **Vaccines.**
(18) **Silver salts** (discoloration).
(19) **Sulphonethylmethane.**
(20) **Sulphonmethane.**

The following very rarely produce an eruption: Iron, strychnine, creosote, mercury, veratrum viride, aconite, digitalis, sulphur, antimony, santonin and cod liver oil.

The Diaphoretics

PILOCARPUS

For the Preparations of Pilocarpus *see* p. 133.

Action of Pilocarpus

External.—None.

Internal. *Gastro-intestinal Tract.*—Pilocarpine, which is promptly absorbed, is a glandular stimulant of extraordinary power. Its first effect is seen in a **marked increase** of the **saliva,** which contains the drug as well as an abundance of salts and ptyalin which will readily convert starch into sugar. There is a feeling of warmth in the mouth, and often a sensation of tenseness about the salivary glands. The seat of the stimulation is the **terminations** of the **secretory nerves.** That it does not reside in the cells is shown by the fact that the action of the drug is instantly antagonized by atropine, which acts upon the nervous structures alone, and not upon the secretory cells; and that it is not central in character is evident from the fact that section of the secretory nerves does not materially alter the action. Nausea, retching and vomiting are occasionally observed, and there is always some increase in the gastric and pancreatic secretions. **Peristalsis is increased** by the contraction of the intestinal muscle from the stimulation of its peripheral nervous apparatus; an increase in the intestinal secretion seems highly probable. Unstriped muscle generally, with the exception of that of the blood-vessels, appears to be thrown into contraction, more marked in the bowel than elsewhere; so that repeated diarrhœal evacuations occur, accompanied with colic. This muscular action also takes place independently of the central nervous system, and is due to action upon the ends of the nerves governing the muscle and is antagonized by atropine in the same way as the effect on the glandular secretions. The secretion of bile is not directly affected.

Eye.—**Myosis** (contraction of the pupil) and spasm of accommodation are produced through stimulation of the motor oculi terminations, and are antagonized by atropine. The intra-ocular tension is

reduced, after a temporary increase; myosis being generally attended with lowered tension.

Skin.—Shortly after the augmentation of the salivary secretion begins, there follow a flow of tears and **excessive perspiration,** in which the remedy is also eliminated, demonstrating that pilocarpus is the **most efficient diaphoretic** of all known drugs. The increase in the secretions is mainly due to water; although the solids are also increased, but owing to the excess of fluid poured out, their percentage is diminished. The mucous glands of the mouth, throat, nose and deeper respiratory passages, as well as the cerumen-producing glands of the ears, all participate in the activity induced by the pilocarpine stimulation. The effect upon the secretion of milk is doubtful. Under treatment by pilocarpus the hair grows more luxuriantly, but it becomes quite coarse.

Circulation.—Pilocarpine markedly accelerates the pulse, with increased blood-pressure and later with arrhythmia. This is attributed to vagus paralysis, though the rise of blood-pressure is believed to be partly due to a stimulation of the vaso-motor centers. Under large doses there follows slowing of the pulse and slight weakening of the heart muscle, with **fall of blood-pressure;** and this action is believed to be from the stimulation of the terminals of the vagus and is prevented by atropine. The increased activity of the glands is accompanied by an acceleration of the blood current through them, with dilatation of the vessels, probably not due to the direct action of the drug on the latter, but simply a result of the stimulus imparted to the glands. After its use there is frequently noticed a **redness of the skin,** especially of the face, due to the **vascular dilatation** accompanying the increased activity of the sweat glands. The sugar of the blood has been found increased, attributed to the action of pilocarpine on the terminations of the nerves in the liver which regulate the glycogenic function of that organ.

Respiration.—The respiration is often quick and dyspnœic, with probably some depression of the respiratory center, and râles may be heard over the bronchi, denoting an accumulation of mucus in them; the bronchial secretion being markedly augmented. The effect of ordinary doses on the respiration is merely an indirect one, resulting from changes in the circulation which diminish the amount of blood passing through the lungs and tend to produce

asphyxial dyspnœa, œdema of the lungs and, after very large doses, collapse and death.

Central Nervous System.—In experiments on animals it is found that the effects here are mainly depressing, and appear late, being entirely overshadowed by the peripheral actions. Vaso-motor paralysis is a rather early and prominent symptom; it leads to dyspnœa. Later, the respiratory center is also depressed; œdema of the lungs, consisting rather in the aspiration of bronchial exudation than in a true serous effusion, although this is often present, consequent on the weakened heart and obstruction of the bronchi by mucus, is a frequent occurrence. The motor centers, especially those of the cord, show some stimulation, as is shown by increased reflexes, tremors and convulsions and later paralysis.

Urinary Organs.—The urine, like the bile, does not seem to be affected directly, although it may be reduced in quantity or otherwise modified by the withdrawal of a large amount of fluid from the body by the sweat and other secretions. The bladder muscle participates in the general contraction of unstriped muscular fiber induced by the drug, and repeated urination and tenesmus may occur. Pilocarpine is excreted unchanged in the urine.

Uterus.—The spleen and bronchi contract under the influence of pilocarpine upon unstriped muscle, and the uterus is supposed to be affected in the same manner; occasionally abortion has been attributed to the drug.

Temperature.—In consequence of the hyperæmia of the skin the temperature is apt to be temporarily elevated, but there soon follows a decided fall, which is apparently due in great measure to the evaporation of the perspiration. The decline in body-heat is maintained on an average for about four and a half hours.

The most important effects of pilocarpine on the system are the **diaphoresis,** the **salivation,** and the **myosis.** The antagonism to atropine is complete in the nerve terminations in both glands and muscles. The alkaloid pilocarpine is generally employed, as it is more prompt and efficient in its action, as well as less liable to disagree with the stomach. Children usually bear large doses of it well.

Therapeutics of Pilocarpus

External.—For promoting the growth of the hair a lotion, applied with friction, consisting of: Fluidextract of pilocarpus, 15; soap

liniment, 15; cologne, 60; may be employed. Pilocarpus, and its preparations also, render the hair darker in color. The fluidextract has been employed as a local application in eczema and erysipelas. Pilocarpine is used topically as a myotic in many eye affections.

Internal.—Pilocarpine may be used whenever a **prompt diaphoretic** effect is desired. It is most commonly employed to produce sweating in cases of Bright's disease. The usual practice is to administer 0.01 gm. (⅙ gr.), or more, of pilocarpine hydrochloride or nitrate, in the evening, aiding the sweating by wrapping the patient in warm blankets, applying heat to the feet, and administering hot drinks. As soon as the sweating has ceased he should be rubbed dry and left in a dry blanket. In this affection the drug is often of great service by relieving the kidneys, by eliminating toxins from the blood and diminishing the inflammatory condition in the kidneys by lowering the blood-pressure. On account of its depressing action on the heart, it should always be used with great caution when there is any cardiac disease present, and alcohol or strychnine may often be administered with advantage. By some, pilocarpine is never employed in chronic parenchymatous nephritis, and it is generally held that it is contra-indicated in the nephritis of middle or advanced age associated with cardiac changes. Theoretically it is the most prompt and efficient remedy at our disposal in **uræmia**, and in many instances it is of great service. In dropsy due to organic disease of the heart it is generally too depressing, and fatal results may attend its use. Injected subcutaneously every second day, it has proved successful in the treatment of some instances of catarrhal jaundice of a persistent type. It has been used as an expectorant in the first stage of catarrhal bronchitis but the salivation and sweating are very untoward symptoms and other remedies are preferred. Its hypodermatic administration has been highly recommended as a preventive and curative measure in the early stages of erysipelas, and has been found effective in instances of obstinate aural vertigo, due particularly to labyrinthine disease. Deafness resulting from disease of the auditory nerve or its terminations is sometimes relieved by pilocarpine, and the drug is often given internally for deafness due to *otitis media sicca*. Locally applied, pilocarpine is of service to relieve pain after excessive use of the eyes, or to ameliorate congestive conditions, and in small doses, internally, has been shown to be a good remedy in tobacco and alcoholic amblyopia. Among other diseases of the eye

in which it has been employed are detachment of the retina, chronic iritis, keratitis, hæmorrhages into the vitreous, hæmorrhages and exudations of the retina, glaucoma, atrophic choroiditis, and commencing atrophy of the optic nerve. Efficient aid to the action of iodides and mercurials in the removal of exudations has been rendered by the use of pilocarpine, which is here given chiefly for the purpose of increasing the rate at which the exudates, liquefied by the agents mentioned, are taken up and excreted. In the case of gummata it is advised that the remedy should be exhibited once or twice a day. In subacute and so-called muscular rheumatism, as well as in dry and scaly skin eruptions, it may often be used with great advantage. Injected subcutaneously, pilocarpine is sometimes successfully employed as an antidote in belladonna or atropine poisoning.

TOXICOLOGY

Death very rarely results from the use of pilocarpus or its alkaloids. When it does occur, it is from paralysis of the heart or œdema of the lungs. *Treatment.*—Atropine is a physiological antidote. In addition to its use, the general treatment of alkaloidal poisoning is called for.

ANTIMONY

For the Preparations of Antimony and Potassium Tartrate *see* p. 47.

Action of Antimony and Potassium Tartrate

External.—It is a powerful **local irritant.** Tartar emetic produces a pustular eruption; if it is persistently rubbed on the skin, this may become confluent and form small abscesses, and, later, extensive ulceration. A solution of antimony chloride, not official, in hydrochloric acid, is a severe **caustic.**

Internal. *Alimentary Canal.*—Antimony acts very much like arsenic, though differing from the latter in the severity of its local action, in provoking more nausea and in being absorbed more slowly. In large doses by the mouth, or if injected into the circulation, its effects are found to be practically identical with those of arsenic, but **vomiting** is always a **prominent symptom,** the poison being rapidly excreted into the alimentary canal. The only result of very small doses of tartar emetic is the production of some perspiration. In

somewhat larger amounts, by its direct action on the walls of the stomach, it causes nausea and vomiting with marked prostration and the usual accompaniments of emesis, such as salivation, sweating and quickened pulse. Poisonous doses give rise to violent and continuous vomiting, the vomit, consisting of mucus, which eventually may have blood mixed with it. With the vomiting are associated profuse watery diarrhœa, great muscular weakness, and collapse, with cold perspiration, clammy skin, and cyanosis of the face and extremities. When injected directly into the blood it also produces vomiting, but it is found that much larger quantities are required than by the mouth. Moreover, a portion of the antimony which is injected intravenously is carried to the stomach and intestines, where it causes local irritation. The emesis is due entirely to its effects as a gastric irritant. It is true that, when injected into the circulation, it may have an emetic effect even if the stomach is replaced by a bladder, as has been shown; although the antimony cannot act locally under these circumstances, it may induce vomiting by causing irritation of some other part of the alimentary tract. While large quantities affect the gastro-intestinal tract much in the same way as arsenic, causing hyperæmia and swelling of the mucous membrane, medicinal doses do not cause any such effects. Even with large doses, however, the intestine may remain unaffected, both because antimony is absorbed more slowly and the larger portion of the poison is usually gotten rid of by vomiting.

Heart and Circulation.—Antimony is a direct **depressant** to the **cardiac muscle.** The temporary acceleration of the pulse is the effect of the vomiting, and is succeeded by a diminution in both the frequency and force of the heart-beat. The final stoppage of the organ takes place in diastole. There is no evidence that the cardiac nerves are affected. There is a continuous fall in blood-pressure, due in some measure to the weakness of the heart, but principally to the effect of the drug on some part of the vaso-motor system. The peripheral nerves and muscles of the vessels are known to be implicated, though it is uncertain whether the vaso-motor center shares in the action.

Respiration.—Like the pulse, the respiration is often quickened at first, and may be shallow and irregular from the nausea, but in poisoning it becomes slow and labored, due to the disturbance of the circulation and the irritation of the alimentary canal, though the respira-

tory center may possibly be in some degree directly acted upon, and it eventually ceases at the same time as the heart.

Nervous System.—Though the effects on the circulation and alimentary canal render the true nature of the nervous action obscure, there is a reason for believing that the depression and collapse are due to the gastric irritation and slowed circulation, and not to any involvement of the peripheral nerves.

Temperature.—Antimony, in considerable doses, produces a **marked reduction** of temperature, attributed to the slowness of the circulation, the general depression and collapse, and the profuse sweating.

Secretion and Excretion.—Such secretions as the sweat, the saliva, and the mucus of the respiratory tract are increased by antimony, not in consequence of any direct action upon the glands, but simply as a result of emesis caused by the drug. Its action on the urinary secretion is not very marked; sometimes being more or less increased, and sometimes diminished or even entirely suppressed. This has been explained by the suggestion that there is a temporary stimulation of the renal epithelium, but that later, when a larger amount of the antimony has been absorbed, an acute irritation of the kidneys is excited. The prolonged use of the drug, as is the fact with arsenic, is liable to induce fatty degeneration of many organs and abrogation of the glycogenic function of the liver, while the nitrogen of the urine is increased. Antimony is absorbed from the gastro-intestinal tract and very slowly from the skin, and it passes into the tissues much more gradually than arsenic; consequently doses can be chosen whose only action is to produce nausea, or, if somewhat larger, vomiting. After absorption it is stored in considerable amount in the liver. It is excreted into the stomach and intestine, in the urine, and also probably in the bile and milk.

Therapeutics of Antimony and Potassium Tartrate

External.—A solution of antimony chloride, not official, known as butter of antimony, was once used as a caustic, but its employment has been abandoned, as the sore produced was difficult to heal.

Internal.—Tartar emetic is now employed to a limited extent in diseases of the respiratory passages. In the early stage of acute bronchitis, it is used in doses, insufficient to produce emesis, where it

serves to **promote secretion,** thus rendering tenacious mucus more liquid, diminish fever, induce diaphoresis, and hasten the elimination of inflammatory products. When a free secretion of bronchial mucus has once been established, it should be discontinued, since it is too depressing to constitute a satisfactory expectorant. It is not a suitable preparation for infants or very young children, and compound syrup of squill which is a domestic remedy for croup, has been known to prove fatal. When an emetic is required in laryngitis, bronchitis, or other acute inflammation of the respiratory tract, ipecac is usually preferable. As a diaphoretic, tartar emetic has been largely supplanted by pilocarpine. Recently antimony has been largely used in the treatment of **trypanosomiasis** because of its similar action to that of some of the organic preparations of arsenic. All antimonial preparations are irritant to the intestine if given in sufficient quantity. A round mass of metallic antimony was formerly known as the "family pill," because it could be repeatedly used as a laxative.

TOXICOLOGY

Acute Poisoning.—This has been observed in type-setters and is usually mistaken for poisoning by lead, although the symptoms resemble those of arsenical poisoning (*see* p. 424). *Post-mortem.*—There is hyperæmia, tumefaction and erosion, with ecchymoses, of the gastric and intestinal mucous membranes. Pustules may be found in the mouth, esophagus, stomach and small intestine, and there may be congestion or inflammation of the lungs.

Treatment.—Emetics are seldom required, but if the poison does not cause free vomiting, the stomach should be washed out or emetics administered subcutaneously (apomorphine hydrochloride) or by the mouth (zinc sulphate). A purge may also be given to remove the poison in the bowel. Tannic acid, in repeated doses is used to precipitate the antimony in the stomach and the tannate thus formed should be washed out. A form of tannic acid which is usually readily obtainable is strong tea, which is also serviceable as a stimulant for the collapse. Mucilaginous drinks may likewise be given freely, and stimulants by hypodermatic injection, as well as the external application of heat, are generally called for.

Chronic poisoning. This is very rare, and it is difficult to recognize, as the symptoms are not characteristic. Among them are described headache, dizziness, depression, indistinct sight, nausea and vomiting, dyspepsia with more or less gastric pain, diarrhœa, loss of flesh, albuminuria, general weakness and exhaustion, and finally collapse. As the symptoms resemble those of acute gastro-intestinal catarrh, poisoning with small, repeated doses of antimony is sometimes resorted to criminally, and an instance of the use of the drug for homicidal purposes has recently been the subject of judicial inquiry. Pustular eruptions, it is said, have been observed from the prolonged internal use of tartar emetic.

Post-mortem.—Antimony is said to be found in the liver, kidneys, spleen, bones and muscles, and there is also fatty degeneration of the viscera, especially the liver.

DIVISION VI.—DRUGS ACTING ON THE URINARY SYSTEM

1. *Drugs Increasing the Quantity of Urine Secreted.*—These are called **diuretics.** The kidneys are susceptible to a variety of influences. Thus, anatomically they present two distinct varieties of epithelium and have an extremely abundant supply of vessels and vaso-motor nerves, while the activity of the organs is profoundly affected by variations in the quantity of blood flowing through them. In the present state of our knowledge it is impossible to say in just what manner many diuretics act. Several of them, no doubt, are effective in more ways than one, and the table (*see* page 560), modified from Brunton, presents the various ways in which these agents probably act.

Therapeutics.—Diuretics are used chiefly for the following purposes: (1) To maintain the action of the kidneys. Diminished urinary excretion may be purely functional in its origin, as in fevers, and the free use of water is often very serviceable for this purpose. The ingestion of large quantities greatly increases the urinary flow, and may also increase the solids of the urine. Investigation has shown that when the tissues are full of the products of disintegration the effect of water is very marked, but that upon the wasting processes of the body it exerts no influence; hence, while it may not be possible to produce tissue-disintegration by water, there would seem to be no question that water is capable of washing out the retained products of tissue change. This naturally renders it of value in various diseases. Intestinal lavage (enteroclysis) with normal saline solution, by means of the rectal irrigator, has been found one of the best and most certain of diuretics. Diuretics are used in cardiac and pulmonary affections when, owing to the general vascular disturbance, the quantity of urine becomes diminished. In diseased conditions of the kidney itself the maintenance of the urinary excretion is urgently demanded, but on account of organic changes in the renal secretory structure, it is often the

- **Raise arterial pressure.**
  - **Generally.....**
    - Increased cardiac action. — **Digitalis, Caffeine, Theophylline, Alcohol, Strophanthus, Sparteine.**
    - General vascular contraction. — **Digitalis, Squill, Strychnine.**
  - **Locally in kidney**
    - Contract efferent vessels.
      - Act on vasomotor centers. — **Probably all of the above.**
      - Locally on kidney. — **Caffeine, Buchu, Uva Ursi, Juniper, Copaiba, Turpentine, Cantharides.**
    - Dilate, chiefly locally, renal vessels. — **Caffeine, Theophylline.**
- **Act on secreting nerves or renal cells.**
  - Increase water excreted. — **Caffeine, Calomel, Uva Ursi, Theobromine Sodio-salicylate.**
  - Increase water and solids excreted. — **Phenylcinchoninic Acid, Colchicum, Potassium Acetate, Potassium Citrate, Potassium Nitrate, Sodium Citrate and other salines.**

Sabal and Triticum are reputed to possess diuretic properties but their mode of action is obscure.

fact that diuretics fail to produce their desired effect. In many such conditions it is a question how far it is desirable to stimulate the diseased organ, and in general only the mildest diuretics should be prescribed. When renal inflammation is present, even if it be chronic, irritating diuretics should be avoided. In acute Bright's disease large draughts of water at regular intervals frequently have

a favorable effect; not only greatly increasing the amount of urine, but also lessening the irritation of the kidneys. In violent irritation of the kidneys and perhaps suppression of urine, hypodermatoclysis has proved of great benefit. (2) To get rid of fluid in various parts of the body. For this purpose diuretics, often combined, are employed in all forms of dropsy. (3) To diminish irritation of the genito-urinary organs, as from the deposit of solids from the urine. Here diuretics are of great service by diluting the secretion, and the value of water as an adjuvant to medicinal diuretics should always be taken advantage of. The alkalies are also of special utility.

In the use of diuretics it is important to have in mind that they may act in a variety of ways, and as it is not always possible to determine the precise cause of the deficiency in the urinary excretion, it is customary to prescribe two or more of these drugs in combination.

2. *Drugs Diminishing the Quantity of Urine Secreted.*—These are usually of such a character as to induce acute nephritis when given in large doses; *e.g.*, turpentine, cantharides, phosphorus. They are never given for this purpose in medicine.

3. *Drugs Rendering the Urine Acid.*—Hexamethylenamine is the most reliable remedy to render an alkaline urine acid. The benzoates are also used for this purpose, as benzoic acid during its passage through the kidney is converted into hippuric acid, and they may be given for alkaline decomposition in the urinary passages. The free use of carbonated water increases the acidity of the urine. Salicylic acid is capable of slightly increasing it, and also very large doses of citric and tartaric acids, borax, and possibly benzosulphinide.

4. *Drugs which Render the Urine Alkaline.*—Some **salts** of the **metals, potassium, sodium, lithium** and **calcium** will do this, *e.g.*, the carbonates, borates and hydroxides; in small doses, even the tartrates, citrates, malates, lactates, and acetates, since they are excreted by the kidney as carbonates. Nitric acid is said to increase the amount of ammonia in the urine, and thus to render it slightly alkaline. Ammonium salts given internally do not render the urine alkaline, because they are decomposed in the body, with the formation of urea; they may even increase the acidity from the larger amount of nitric acid excreted.

Antilithics.—These are drugs which tend to prevent the deposition, in the urinary passages, of the solids of the urine. When the secretion is acid, gravel or uric acid calculus is liable to occur from

the crystallization of uric acid, or, more rarely, lime oxalate calculus, from the crystallization of lime oxalate. Whenever a tendency is shown to the formation of either of these calculi, alkalies or other remedies reputed to prevent this should be administered. For uric acid the following are chiefly used; distilled water, potassium salts, and lithium salts. For lime oxalate, dilute nitro-hydrochloric acid, carbonated water, and lactic acid (for indigestion). When, on the other hand, the urine undergoes alkaline decomposition, phosphatic calculi are liable to form from the crystallization of phosphates. Here the aim must be to render the secretion acid and aseptic, and benzoic acid, the benzoates, salicylic acid, the salicylates, as well as hexamethylenamine or other urinary antiseptics, are given for this purpose.

Lithontriptics.—These are agents which are supposed to promote the solution of calculi, but as a matter of fact, not one has as yet been discovered which is capable of dissolving a calculus when once formed. It is true that alkalies have been credited, owing to their action in the test-tube, with the power to dissolve uric acid calculi; but in the body alkalies cannot convert free uric acid into soluble alkaline urates, but, at most, into acid urates, which are found to be almost as insoluble as uric acid itself. Hence, it is believed, it would be quite impossible to effect in this way the solution of even very small calculi.

Therapeutics.—The chief use of alkalies in this connection is to diminish or entirely neutralize the acidity of the urine, and thus prevent so far as possible the precipitation of uric acid. In this way they tend to prevent increase in the size of a stone already formed. They are also of service in lessening the irritability of the urinary passages. In gouty subjects they are prescribed not only to alkalize the blood, but also to alkalize the urine, since in such persons the deposition of uric acid in the urine is common. The citrates and acetates are the best forms in which to give the alkalies, as they are not apt to interfere with the digestion, and potassium and lithium salts are to be preferred, since these metals form more soluble urates than sodium. Copious draughts of water, by diluting the urine, aid in the prevention of calculi, and natural mineral waters, especially those containing lithium, are in very general use.

5. *Drugs Preventing the Urine from Decomposing.*—Urine retained from any cause in the bladder will undergo alkaline decomposition,

and the same result is likely to occur from the admixture of pus, as from cystitis or pyelitis, with the urine. This decomposition of the urine may be prevented by the administration of drugs which in their excretion by the urine render it aseptic. Such are—

(1) **Hexamethylenamine.**	(6) **Copaiba.**
(2) **Benzoic acid.**	(7) **Cubeb.**
(3) **Salicylic acid.**	(8) **Oil of Santal.**
(4) **Uva Ursi.**	(9) **Benzosulphinide.**
(5) **Boric acid.**	(10) **Many volatile oils.**

6. *Drugs Altering the Composition of the Urine.*—Many drugs will do this, either because they are excreted in the urine, or because they set up certain changes in the body the products of which are excreted in the urine; but it will be sufficient to refer to a few striking examples.

Turpentine, cantharides and salicylic acid in large doses will cause hæmaturia for the reason that they produce inflammation of the kidney.

Potassium chlorate, all nitrites, acetanilid, pyrogallol, poisoning by the mushroom (*Helvella esculenta*), and transfusion of alien blood break up red blood-corpuscles, and the products, when excreted, darken the urine. Large doses of mineral acids, arsenic, naphthol and naphthalene may occasionally produce the same result.

Phosphorus in large doses causes leucin and tyrosin to appear in the urine, while the nitrogen is greatly increased.

The saline diuretics cause an increase of the solids of the urine.

The chrysaphanic acid in rhubarb and senna makes the urine, if it is acid, a saffron or brownish color; if it is alkaline, a purplish red. Logwood renders alkaline urine reddish or violet. Santonin colors acid urine greenish-yellow, and alkaline urine, reddish. Phenol, naphthalene, creosote and other tar preparations, the arbutin in uva ursi, chimaphila and gaultheria make it dark greenish-brown. Picric acid makes it a bright yellow, methylene blue, greenish, and methyl violet, blue. The urine of persons poisoned with carbonic oxide remains sweet for months.

Poisoning by carbonic oxide, amyl nitrite, and turpentine, and sometimes chloroform, camphor, mercury, morphine, hydrocyanic acid, sulphuric acid, alcohol, lead compounds, and salicylic acid, excrete a substance in the urine, which, like sugar, reduces Fehling's copper solution. After some of these drugs, at least, the urine does not contain glucose, but glycuronic acid; for although it reduces blue copper solutions, it does not give the phenyl-hydrazin test, nor undergo alcoholic fermentation on the addition of yeast. Hydrated chloral was formerly supposed to induce glycosuria, but this has been shown not to be the fact, the reducing agent in the urine being urochloralic acid, and not sugar. The administration of phloridzin, a glucoside from the bark of stems and roots of the apple, pear, plum and cherry, which, when continuously heated with

dilute mineral acids, is resolved into glucose and phloretin, leads to the production of glucose in the urine.

Some drugs impart a peculiar odor to the urine; for instance, the smell of violets is produced by turpentine, oil of juniper, and oil of rosemary. The aromatic odor of cubeb and copaiba can be detected in the urine after their administration.

Prolonged poisoning by lead often induces chronic nephritis. This is usually of the granular type, but in some instances the kidney presents a mixture of interstitial and parenchymatous disease. In acute mercurial poisoning, when death does not follow in the course of a few hours, anuria is not infrequently observed, and this has been found to be due to renal changes, the most prominent feature of which is necrosis of the epithelium of the tubules. Fatty degeneration of the renal epithelium may be caused by phosphorus and arsenic.

7. *Drugs Acting on the Bladder and Urethra.*—Practically, the only ones of value are **sedatives** to the urinary tract.

If the urine shows a tendency to decompose, the drugs which prevent decomposition, and if the urine is excessively acid, alkalies, act as urinary sedatives. Other sedatives are **opium, belladonna, hyoscyamus, stramonium, triticum, buchu** and **uva ursi,** which are direct sedatives to the vesical and urethral mucous membranes.

Urinary sedatives are used very largely in the treatment of cystitis and urethritis, whatever may be the cause. Locally, astringent and antiseptic injections are employed in addition.

The Diuretics

WATER

For the Preparations of Water *see* p. 39.

Action of Water

External.—An *indifferent* bath (31.1° to 36.6°C.—88° to 98°F.) produces no particular effect.

In a healthy individual a *cold* bath causes at first a feeling of extreme chilliness, the teeth chatter, and the extremities are blue and covered with *cutis anserina,* because the blood is driven away from the surface, which is consequently left cold. The abstraction of heat lowers the bodily temperature, as the calorific centers are not able to produce all the heat required for the preservation of the normal temperature. Very shortly, however, reaction sets in; the extremities grow warm, the pulse grows stronger and more rapid, and the respiration, which was at first gasping, becomes full and regu-

lar. Every portion of the body now receives a more perfect supply of blood, and a general feeling of exhilaration is experienced, which, if the bath is left at this stage, often remains for many hours. This action is explained by the fact that cold always contracts the blood-vessels and reflexly stimulates the vital centers to increased activity. If the bath is unduly prolonged, the system suffers from the effects of over-stimulation, with more or less profound depression of the nervous system and circulation, and consequent interference with functional activity. The proper duration and temperature of the cold bath differs very greatly for different individuals, and its daily use diminishes the liability to acquire colds.

Warm baths cause flushing of the skin and have the effect of accelerating the pulse and respiration, and raise the temperature of the body by imparting heat to it and preventing loss of warmth from it. After the bath profuse perspiration results, while the excretion of urine is diminished. Owing to the dilatation of the cutaneous vessels caused by warm baths, the blood is withdrawn to a considerable extent from the internal organs, and in consequence of this their functional activity is lessened.

Internal.—Water if ingested in sufficient quantities, washes out the tissues and increases the flow of urine. Taken habitually in sufficient quantity, it somewhat augments the excretion of urea, while the amount of uric acid is said to be diminished. It has considerable effect in **promoting tissue metamorphosis,** through the increased movement of the lymph flushing out the cells and leading to a more complete removal of the waste products, but this is not pronounced, as the increase in the nitrogen and sulphur eliminated in the urine has been found to amount to only 5 per cent., or less. Lukewarm water, as is well known, will cause nausea and vomiting, while hot water, in small amounts frequently repeated, is often very useful in controlling irritability of the stomach.

Therapeutics of Water

External.—Cold baths are used for the subsequent exhilarating effects, which may be increased by brisk rubbing with a rough towel, but persons whose systems do not promptly react afterward should not resort to them. Cold salt baths, particularly if they are sea baths, are more stimulating than fresh-water bathing. So far from

a cold bath being dangerous to the over-heated, persons with healthy circulations find nothing so refreshing and preventive of muscular stiffness after severe exercise as a brief cold plunge- or shower-bath. **Cold baths** at the present time are more or less frequently employed in the treatment of **febrile diseases**, more particularly **typhoid fever**; Vogel's statistics show a reduction of mortality to 2.07 per cent. under what is known as the Brand (really Currie-Jürgensen) treatment. The latter consists in the use of water at about 21.1°C. (70°F.), for fifteen minutes every three or four hours, when the rectal temperature is at or above 39.4°C. (103°F.). In applying the method, the temperature of the bath is made at first about 29.4°C. (85°F.), and in each successive bath the temperature is lowered 2.8°C. (5°F.), until 18.3°C. (65°F.) is reached. Sometimes a bath is employed at a temperature 5.5°C. (10°F.) below that of the patient, and the water is then cooled by adding cold water or ice until it falls to a temperature of about 20°C. (68°F.). In these baths the patient is lowered into the tub by means of a sheet, and on being lifted back into bed is carefully dried, without rubbing, and left covered with a sheet or blanket. Brisk rubbing of the whole body should be carried out during the bath, and the feet kept warm. Cold baths are no longer used in the treatment of typhoid fever with the notion that they simply reduce temperature, or are useful for the stimulation of the nervous system but for the marked diuresis which they produce, thus, supposedly, favoring the elimination of toxins by the urine. This treatment is, of course, symptomatic and eventually will give place to a more scientific method, namely the prevention of toxin-formation. If for any reason the use of the cold bath is unadvisable, various substitutes for this may be resorted to, such as sponging, affusion, or the cold pack. The latter consists of a sheet, four folds thick, wrung out in cold water and wrapped around the naked body for five or ten minutes at a time. Affusions were employed as long ago as 1795 by Currie, and in the form known as "slush baths" were used with excellent effect among troops in the Spanish-American war. Rubbing the surface with pieces of ice is also sometimes practised. In pneumonia the cold bath is occasionally used, when the fever is high, but cold is more commonly applied by means of powdered ice, which, confined in rubber tissue, is placed in a flannel bag and bound to the chest over a layer of cotton. Cold baths are also sometimes of service in entero-colitis and in acute rheumatism

with high fever, and they undoubtedly constitute an excellent treatment for any sudden hyperpyrexia. Thus, ice-water baths are of the greatest possible service in thermic fever, care being taken that friction of the skin is at the same time employed. Cold water may also be injected into the bowel in instances where the skin is cold but the central temperature very high. The application of ice-bags or of the cold water coil to various parts of the body is used for controlling inflammatory action and sometimes also for the **hæmostatic** effect of the cold, as in pulmonary hæmorrhage, by its vaso-constricting action.

A cold bath is one the temperature of which is below 21°C. (70°F.), and a hot bath one with a temperature above 36.6°C. (98°F.). Anything between 31.1° and 36.6°C. (88° and 98°F.) is really an indifferent, more properly, tepid bath. Hot baths, as they have the effect of liquefying the fatty secretions, are naturally more cleansing than cold. Like the application of heat in other forms, they **soothe pain,** and they are useful in alleviating muscular and mental fatigue and various inflammatory conditions. They also serve to **relieve muscular spasm,** as well as internal congestion, by withdrawing blood from the internal organs to the surface, and often prove of great value in colic, spasmodic stricture of the urethra, laryngeal spasm, infantile convulsions, etc. Hot baths and the hot pack are useful in renal disease and uræmia, and in commencing colds, on account of the **free diaphoresis** which they induce; and after a hot bath the patient should be immediately wrapped in warm blankets and put to bed, in order to prevent contraction of the cutaneous blood-vessels and arrest of perspiration. A hot bath of the temperature of 40°C. (104°F.), at bedtime is not infrequently of service in insomnia. The hot vapor, or Russian, bath is employed for many of the same purposes as the hot air, or Turkish, bath, and particularly when the skin or kidneys are inactive, but is not so generally useful, as no evaporation of perspiration can take place during the bath. A valuable method for using the hot vapor bath in a mild form is the "bronchitis tent," which consists of a bed canopy made by sheets, into which the steam arising from a steam atomizer is introduced by means of a tube. While equally efficacious in the first stage of bronchitis in adults, it is more conveniently employed in the instances of children on account of the size of the bed.

Localized hot baths act in the same way as general ones, but are

less pronounced in their effects. A hot sitz bath causes dilatation of the vessels of the pelvic viscera and a hot foot bath of proper depth, dilatation of the branches of the femoral and probably of the iliac arteries. Mustard is often added to increase the effect, and both these forms are much used in amenorrhœa. The sitz bath is more particularly suited to spasmodic dysmenorrhœa, and the foot bath is commonly employed in the first stage of a cold. In gonorrhœa a hot sitz bath is a good prophylactic against chordee. In spasmodic croup benefit may be derived from the application to the neck of a hot compress made from several layers of flannel wrung out of water and covered with cotton and oiled silk. In various painful inflammatory affections of the eyes much relief may be derived from the use of hot water applied by cotton pledgets, frequently renewed, or allowed to drop continuously upon the eye from a fountain syringe. Irrigation with plain hot water, or with normal saline solution (*see* p. 386) has proved of great service in markedly lessening tenesmus in acute dysentery. Enteroclysis is now also employed with advantage in a variety of other conditions, among which may be mentioned collapse, nephritis, especially acute uræmia, auto-infection from retention of putrid material in the intestine, cholera infantum, toxæmia in fevers, particularly typhoid, septic endocarditis and septic conditions generally, pelvic and genito-urinary inflammations, and hæmorrhage in the rectum or adjacent organs. In fact in typhoid fever the benefits claimed from the Currie-Jürgensen method are quite as readily and far more comfortably obtained by high colonic irrigation with water of proper temperature.

Internal.—Water is principally used to wash out the tissues and for its supposed effect upon **tissue metamorphosis** and the **excretions.** It is of great service in keeping the urine diluted. By its free use the liability to the formation of gall-stones may be diminished, in consequence of its effect in increasing the watery secretion of bile, so that the bile becomes less concentrated and flows more freely. The liability to the formation of gravel or urinary calculi is also lessened, as the crystals composing such calculi are washed out of the urinary tract before an opportunity is afforded them of forming in large aggregations, while if they consist of uric acid, the habitual use of a sufficient quantity of water, as has been mentioned, tends to diminish the excretion of that substance. When large amounts of water are taken, pure or distilled water should be used, and it should be drunk for the

most part between meals. One or more glasses of cold water swallowed upon rising has the effect in some individuals of causing an evacuation of the bowels. Tepid water, to which mustard is often added, is very commonly used as an emetic. The natural mineral waters employed for baths and internal medicinal use are only incidentally mentioned in a work on therapeutics, as their principal ingredients come under consideration.

SPARTEINE SULPHATE

For the Preparation of Sparteine Sulphate *see* p. 138.

Action of Sparteine Sulphate

External.—None.

Internal. *Nervous System.*—Sparteine sulphate if given in poisonous doses causes, in the lower animals, incoördination, exaggerated reflexes, and convulsions, followed by enfeeblement of all the functions, paralysis, and death from asphyxia.

Respiration.—It paralyzes the respiratory centers and the motor centers of the spinal cord, but has a very slight influence upon the muscles; lessening, though not destroying, their excitability.

Circulation.—Under the influence of this alkaloid, it is stated, there is a very great **increase** in the size and **height** of the **cardiac wave.** If the dose has been a small one, the pulse is at first accelerated; after large doses there is a slowing, followed by enfeeblement of the heart. The arterial pressure is not materially changed unless the dose is toxic, when it falls. Small doses weaken, and large ones paralyze the pneumogastric; upon the vaso-motor system it appears to have no influence, unless in very large toxic doses, when it may perhaps act as a paralyzant.

Kidneys.—It has a well-marked **diuretic** action according to clinical evidence.

Therapeutics of Sparteine Sulphate

It is a very useful **diuretic** in dropsy from heart disease or chronic nephritis. In acute nephritis, or where pulmonary congestion or inflammation is present, it is contra-indicated. According to some, it is of very great value in producing **regularity** in instances of

irregular cardiac action. It accelerates the beats when weak, and has the great advantage of acting quickly. On the whole, it is inferior to digitalis in power, but it is not cumulative, and is a useful remedy in uncompensated cardiac, especially mitral, disease.

BUCHU

For the Preparations of Buchu *see* p. 212.

Action and Therapeutics of Buchu

Buchu stimulates the appetite and slightly increases the pulse-rate. Its volatile oil is excreted by the kidneys, by the bronchial mucous membrane which it stimulates, and probably also by the skin, as it induces **mild diaphoresis.** The excretion is chiefly in the urine, which it renders slightly **antiseptic,** but, although it is generally regarded as a diuretic, it does not appear to appreciably increase the renal activity. Under its influence the urine becomes darker in color, assumes an aromatic odor, and deposits a brownish sediment. After its elimination by the kidneys it acts as a **disinfectant** to the **urinary tract.**

The chief therapeutic use of buchu is in chronic affections of the mucous membrane of the genito-urinary tract, and it is a valuable remedy in pyelitis, lithiasis, cystitis, urethritis, and prostatitis. It is also occasionally prescribed as an expectorant in bronchitis.

THEOPHYLLINE

For the Preparation of Theophylline *see* p. 172.

Action of Theophylline

The action of this remedy resembles that of caffeine excepting that it is a much more active diuretic, increasing both the excretion of water and of the solids from the kidney. Occasionally it produces untoward symptoms, commonly headache and gastric irritation and rarely vomiting and in isolated instances possibly epileptiform convulsions.

Therapeutics of Theophylline

The results of the administration of this remedy have been positive in both cardiac and renal œdemas. Its maximum effects are usually

produced upon the second or third day of its administration, but sometimes its continuance is without marked effect.

THEOBROMINE SODIO-SALICYLATE

For the Preparation of Theobromine Sodio-salicylate *see* p. 172.

Action of Theobromine Sodio-salicylate

This substance is rapidly absorbed, excreted as such or as methyl-xanthine and appears to have a direct action upon renal epithelium producing a **flow of urine** but without irritating the kidneys or disturbing other than slightly strengthening the normal heart action. It has no vaso-constrictor properties and but little effect upon the cerebrum, in causing wakefulness, so that the doses may be large.

Therapeutics of Theobromine Sodio-salicylate

It has an established reputation as a **diuretic** which usually yields prompt and satisfactory results. It is of most benefit in anasarca due to cardiac or hepatic disease; if due to renal disease the results depend entirely how far the degenerated kidneys are able to respond. It is reasonably safe in **acute nephritis** although it has, with great infrequency, been known to cause headaches, irregularity of pulse, vomiting, diarrhœa and possibly hæmaturia. Notwithstanding these observations the administration of from 4 to 8 gm. (1 to 2 dr.) is considered to be safe and generally results in an increased flow of urine, often in **enormous quantities.**

PHENYLCINCHONINIC ACID

For the Preparation of Phenylcinchoninic Acid *see* p. 107.

Action of Phenylcinchoninic Acid

Phenylcinchoninic acid stimulates the kidneys by acting chiefly upon the secreting cells, increasing the flow of urine, but not the excretion of purin bases and phosphoric acid and markedly augmenting the **elimination of uric acid,** its action being stronger and more prompt than the salicylates. The ammonia and total nitrogen in the urine show a slight increase but not in proportion to the marked increase in uric acid. There is no evidence that it causes an increased formation of uric acid nor does it have any effect on deposited urates. Its action, however, terminates in about nine hours.

Therapeutics of Phenylcinchoninic Acid

It should always be administered in large quantities of water. In acute attacks of **gout** it relieves pain more promptly than colchicum but without disagreeable after-effects. In order to prevent the formation of uric acid calculi during its rapid elimination it recommended that sodium bicarbonate be administered, 15 gm. (½ oz.) on the first day and 5 to 10 gm. (75 to 150 gr.) on the succeeding days of treatment. The gouty tophi are said to become smaller, but this is probably not the fact. In acute articular rheumatism the results of its administration are sometimes favorable in relieving pain but it is not so satisfactory as the salicylates. In the chronic forms its action is variable. In sciatica it sometimes relieves pain but is more likely to fail.

UVA URSI

For the Preparations of Uva Ursi *see* p. 173.

Action and Therapeutics of Uva Ursi

The diuretic effect of uva ursi seems to be unquestionably due to the direct action of the drug upon the renal epithelium. It also has a decidedly **anti-putrefactive** effect upon the **urine,** which is believed to be due to the glucoside arbutin which it contains; which, in addition to exerting a moderate stimulant action on the kidney cells, appears to be somewhat antiseptic. Uva ursi is therefore a mild disinfectant to the urinary tract in gonorrhœa, for instance. Under its influence the urine not only increases in amount but often becomes dark in color, the discoloration becoming more marked when it is allowed to stand, and this is due to the hydroquinone yielded by the arbutin, which becomes further oxidized and forms a brownish-green pigment similar to that observed after phenol and other agents.

SABAL

For the Preparations of Sabal *see* p. 174.

Action and Therapeutics of Sabal

Sabal is a **mild diuretic.** It volatile oil is excreted mainly by the mucous membranes, and on these its principal effects are exerted.

In general, catarrhal conditions of the genito-urinary tract are improved by sabal, especially when the fluidextract is combined with oil of santal. It is given in cystitis and to relieve the vesical distress of prostatic hypertrophy and is believed to be effective in **functional impotence,** especially if it be senile.

JUNIPER

For the Preparations of Oil of Juniper *see* p. 212.

Action of Oil of Juniper

Oil of juniper is diaphoretic, diuretic and aphrodisiac. Its action is practically the same as that of oil of turpentine, but it is less apt to interfere with the digestion or to cause hæmaturia and albuminuria. It is, however, a powerful **renal stimulant** and in large doses irritant; so that from sufficient amounts there may result strangury, priapism, hæmaturia, suppression of urine, and uræmic convulsions. It imparts a violaceous odor to the urine, and will produce diuresis even when inhaled.

Therapeutics of Oil of Juniper

It is a very efficient diuretic, and is used, combined with other less irritant diuretics, in the treatment of dropsies resulting from cirrhosis of the liver, organic heart disease, and chronic Bright's disease. The compound spirit may be given to patients suffering from such affections who require an alcoholic stimulant. It is a favorite remedy among women who suffer from **dysmenorrhœa.** The oil may be used in chronic pyelitis, cystitis, prostatorrhœa and gleet, but never when acute nephritis is present.

TRITICUM

For the Preparations of Triticum *see* p. 173.

Action and Therapeutics of Triticum

Triticum is **mildly diuretic** and **demulcent,** for which it enjoys a considerable reputation.

For its soothing and supposed diuretic properties it has been used

in dysuria, irritability of the bladder, chronic cystitis, irritable prostate, gleet, and other affections of the genito-urinary tract.

Drugs Preventing the Urine from Decomposing

HEXAMETHYLENAMINE

For the Preparations of Hexamethylenamine *see* p. 97.

Action of Hexamethylenamine

Of most importance is the **inhibitory action** of this remedy **upon micro-organisms** when it is split up into formaldehyde and ammonia, the former being the active agent. This takes place for the most part after ingestion, in the urine, which is not only of the proper temperature for the purpose, but also contains uric acid and acid salts, which are efficient aids to this dissociation. Its germicidal action is less pronounced in urines of low acidity or when alkaline. In an ammoniacal urine there is little if any effect owing to the ready combination of formaldehyde with ammonia.

Therapeutics of Hexamethylenamine

Hexamethylenamine is one of the most important of recent additions to practical therapeutics and is of especial value in diseases of the urinary passages. In decomposition of the urine, which is extremely frequent in the **cystitis** of prostatic hypertrophy, the maximum dose given for two or three successive days is efficient in clearing that excretion. An excessively alkaline urine in these patients can be rendered faintly acid by acid sodium phosphate but this need not be given at the same time. Inasmuch as the growth of the micro-organisms is only inhibited, the remedy should be continued in sufficient amount to maintain this result. In gonorrhœal posterior urethritis, cystitis and pyelitis the results are equally favorable. It may be employed as a **prophylactic** measure before operations upon the genito-urinary tract. Since it is not always diuretic, other measures should be employed to increase kidney action, especially its administration with large amounts of water. For **phosphaturia** excellent results are reported. Inasmuch as the specific bacillus of the disease is found in a very considerable percentage of urines from patients suffering from **typhoid fever**, and failure to disinfect this

excretion is a source of danger, hexamethylenamine should be administered not only for this purpose but also in order to avoid the cystitis which sometimes supervenes in the course of this disease. It has been employed in the treatment of infections of the bile ducts and of the gall-bladder, in large doses, with good results. It is claimed that, inasmuch as after absorption, it is found in the cerebrospinal fluid, it should be employed in infectious diseases affecting the nervous system as **meningitis** and **poliomyelitis.** It has been recommended for pellagra. It is the most potent remedy in the treatment of general **infection by the colon bacillus.**

Notwithstanding the fact that no instance of poisoning, so far as is known, has occurred from the use of even the large doses which are required in diseases of the bile tract and in those of the nervous system certain symptoms arise which cause much discomfort. These are excessive acidity so that the urine is irritating, considerable vesical pain, diarrhœa and abdominal pain, headache and tinnitus, and an eruption resembling measles. When these symptoms become marked the amount must be diminished.

BENZOIC ACID

For the Preparations of Benzoic Acid *see* p. 174.

Action of Benzoic Acid

As benzoic acid, the benzoates, and benzoin all have practically the same action, that of benzoic acid only will be described.

External.—It is irritant to mucous membranes, and its vapor when inhaled is capable of exciting a catarrhal condition of the bronchial membrane; in a concentrated form it is irritant to the skin. In antiseptic power it appears to be equal, if not superior, to salicylic acid, preventing the growth of many forms of bacteria in a solution of 1 in 1,000.

Internal.—In the body its action is in many respects very similar to that of salicylic acid, and it may be taken in comparatively large quantities without the production of toxic symptoms. In very large doses it sometimes causes nausea and vomiting, and inoccasional instances the matters vomited may be tinged with blood. It produces a moderate acceleration of the pulse, and has some effect in increasing and disinfecting the bronchial secretion. It is therefore regarded as an **expectorant,** and it is probable that either the acid or one of its

derivatives is excreted by the bronchial mucous membrane. It differs from salicylic acid in being less stimulant to the central nervous system, and in man a certain sedative effect has been observed under it. It no doubt lessens the putrefaction in the intestinal canal, as some diminution in the double sulphates and the indican of the urine has been observed after its administration by the mouth. Benzoic acid and the benzoates, particularly sodium benzoate, appear to have the effect of somewhat **stimulating** the functional activity of the **liver.**

An important feature of the action of benzoic acid is that it is in great part excreted in the urine as **hippuric acid,** which is formed in the body from a combination with glycocoll. Some of the benzoic acid escapes in the urine, and the proportion of hippuric acid formed appears to depend more or less upon the condition of the kidneys, in which the synthesis takes place, and of the general health, as well as upon the amount of benzoic acid ingested. It is generally believed that the hippuric acid thus formed increases the acidity of the urine and **renders alkaline urine acid,** while it also tends to **disinfect** and **stimulate** the **genito-urinary tract.** During its excretion by the kidney, benzoic acid slightly stimulates the renal cells, and thus has a mild diuretic effect. After large doses there has sometimes been found in the urine a reducing body, which is presumed to be glycuronic acid. Benzoic acid is found to increase to a considerable extent the nitrogen eliminated in the urine, and it would therefore seem, like salicylic acid, to augment the decomposition of the proteids in the body. The action of benzoic acid on the body-temperature is probably similar to that of salicylic acid. One of the rarer results of the administration of the drug is urticaria or an erythema.

Therapeutics of Benzoic Acid

External.—On account of its marked **antiseptic** qualities, as well as its stimulating effect, the compound tincture of benzoin is quite largely used as a surgical dressing for wounds and ulcers. It sometimes relieves the itching of urticaria or eczema, and, mixed with an equal quantity of glycerin, is serviceable for chapped lips and hands, fissured nipples, and chilblains. A solution of tincture of benzoin in Cologne water is also often successful in urticaria, and a lotion made with the tincture, and containing mercuric chloride, may be applied for the removal of freckles and in pityriasis versicolor and chronic urticaria. In catarrhal affections of the pharynx and larynx

the compound tincture, more or less diluted, makes an efficient application, and the hoarseness of singers and public speakers, the result of undue strain upon the vocal cords, is frequently relieved by this remedy. Benzoinated lard is a favorite basis for ointments, the active ingredient of which it is desired to have absorbed, because the benzoin prevents the decomposition of the lard.

Internal.—*Urinary Organs.*—The chief value of the benzoic compounds is in diseases accompanied by disordered conditions of the urine. Ammonium benzoate is preferable to benzoic acid itself on account of its much greater solubility, and it may, with advantage, be combined with some such sedative as hyoscyamus. Spirit of chloroform is sometimes employed to cover the taste. In **pyelitis** or **cystitis** the alkalinity of an ammoniacal urine is diminished, the hippuric acid which is formed combines with ammonia to form ammonium hippurate, so that less triple phosphate results in consequence, and the condition is therefore ameliorated. As the acidity of the urine is increased by the salts, they may also be of more or less service in **phosphaturia** and in vesical calculus. In fever the transformation of benzoic acid into hippuric acid is much diminished, and in advanced parenchymatous nephritis and amyloid disease of the kidney it is entirely abolished, the benzoates being excreted as such.

Pulmonary Organs.—Benzoin and its derivatives may be of service when the sputum is fetid. The simple or compound tincture is used as an ingredient of **expectorant** mixtures, and is regarded as especially beneficial when the mucus is tenacious and coughed up with difficulty.

Other Uses.—In diseases of the alimentary canal the benzoates have proved of considerable value, being sometimes efficient in chronic diarrhœa and dysentery and the intestinal catarrh of children. In acute rheumatism the benzoates appear to have somewhat the same effects as the salicylates, but are far less efficient. The use of sodium benzoate in food is objectionable, because even in very small quantity, it retards activity of the digestive enzymes.

COPAIBA

For the Preparations of Copaiba *see* p. 213.

Action of Copaiba

External.—Copaiba is an antiseptic slightly stimulating to the skin and mucous membranes.

Internal.—*Gastro-intestinal Tract.* Its taste is very unpleasant, often producing disagreeable eructations. In ordinary doses it causes a pleasant sense of warmth in the stomach, but in large amounts acts as a gastro-intestinal irritant, with the production of vomiting and purging. Although it is less irritant to the stomach than many of the volatile oils, its prolonged administration is apt to give rise to gastric disturbance.

Mucous Membrane.—After entering the circulation it is excreted to a considerable extent by the various mucous membranes, in the process, stimulating their action and also having a **disinfectant** effect. It is thus a stimulating disinfectant to the **bronchial mucous membrane** and that of the **genito-urinary tract,** acting especially on the latter. It imparts to the mucous secretions and breath, as well as to the urine, a peculiar aromatic odor.

Skin.—It appears to be eliminated by the skin also, and in some instances it occasions **cutaneous eruptions** and annoying itching. The more common form of efflorescence is a coarse rash, resembling measles, but sometimes there is urticaria, erythema or a bullous eruption. By some these eruptions have been attributed to the irritant effects of its excretion by the skin; by others to the gastric disturbance caused by the drug.

Kidneys.—Copaiba is **diuretic** not only by virtue of its volatile oil, but also because of its resinous acid. As it exerts an antiseptic action in the urine, the bladder and urethra are bathed in an antiseptic, slightly irritant fluid, which not only tends to retard the growth of microbes, but also to promote the healing of lesions. In large doses it causes irritation in these parts, with a constant desire to micturate. The act of micturition is attended with difficulty and pain, and sometimes the pain is so severe as to lead to complete retention. Large quantities are also irritating to the kidneys, and from this cause may result a diminished secretion, with blood and albumin in the urine. While copaiba is excreted partly by the lungs and mucous membranes and in the milk and other secretions, its main excretion takes place by the kidneys and in combination with glycuronic acid.

Therapeutics of Copaiba

External.—Like the terebinthinates, copaiba serves to stimulate, as well as protect, parts to which it is applied. It is sometimes used as a

dressing for chilblains, frost-bites, anal and other fissures, etc. It has also been used, on account of its **stimulating and antiseptic effects,** in chronic skin diseases, such as psoriasis, lupus and leprosy, and as a topical application to the urethra or vagina in chronic gonorrhœa.

Internal.—Occasionally copaiba is employed as an **expectorant** in bronchitis, especially where the secretion has become profuse and fetid. In chronic conditions it has the effect of diminishing instead of increasing secretion, and on this account as well as its disinfectant properties, it may serve a useful purpose. Its use is restricted at the present time because of its unpleasant taste, the offensive odor which the drug gives to the breath of those taking it, and its liability to cause disagreeable eructations, to derange the digestion, or to produce eruptions on the skin. In **gonorrhœa** it has proved so undeniably efficacious, however, that in spite of the objectionable features attendant upon its administration, it still holds its place as a standard remedy in this disease. It is regarded as safe to begin the use of copaiba in gonorrhœa as soon as the initial severity of the attack has subsided and the bowels have been freely opened.

CUBEB

For the Preparations of Cubeb *see* p. 214.

Action of Cubeb

External.—By reason of its volatile oil, cubeb is irritant and rubefacient when applied by inunction.

Internal.—Its action is much the same as that of copaiba, though it is somewhat less irritant. Large doses cause marked gastric and sometimes intestinal irritation, with nausea, vomiting, abdominal pain, and perhaps purging, while the urine may contain albumin or blood, or both. It is excreted by the kidneys and lungs, and probably by the skin, and its chief action is on the mucous membrane of the **genito-urinary tract.** This is not only powerfully **stimulated** but also **disinfected** by it, as the urine containing the drug acts as a stimulant and antiseptic lotion. It sometimes gives rise to a cutaneous **papular** or **erythematous eruption,** but whether this is due to its excretion by the skin or to the gastric disturbance, is as yet undetermined. As cubeb induces considerable irritation of the kidney, it is a **diuretic.**

Therapeutics of Cubeb

Cubeb is one of the drugs most commonly employed in the treatment of genito-urinary affections, especially **gonorrhœa, gleet and chronic cystitis.** It is considered most valuable in the acute stage of gonorrhœa. It often relieves functional irritability of the bladder, and sometimes checks nocturnal incontinence of urine. Some patients are peculiarly susceptible to its effects, and in them even small doses may produce gastric disturbance or vesical irritation, with bloody urine. In the treatment of affections of the respiratory passages it has an established position. The symptom **asthma** is often relieved by cubeb cigarettes, and these are useful also in sensitive hypertrophies of the nose and in mild bronchitis. The troches are employed by vocalists and public speakers, and many popular ones contain cubeb. It is of considerable service in subacute or chronic bronchitis, especially when there is a profuse muco-purulent secretion.

OIL OF SANTAL

For the Preparations of Oil of Santal *see* p. 215.

Action and Therapeutics of Oil of Santal

The action of the oil of santal closely resembles that of copaiba and cubeb, but it is less irritant, as well as more agreeable to take, than either of the others. Like them, it is a **bronchial** and **genito-urinary stimulant** and **disinfectant.** Its absorption and excretion are very rapid, and it appears in the urine in about half an hour after ingestion by the mouth. After large doses irritation of the alimentary canal and urethra, with an eruption of small red papules upon the skin and conjunctiva, have been observed.

It is best administered in capsules, or in an extemporaneous emulsion, and is much used in **gonorrhœa and gleet.** It is expensive and on this account it is frequently adulterated. The advantage of oil of santal over copaiba and cubeb is that it does not nauseate or disturb digestion, and it can be given with good results during the inflammatory stages of gonorrhœa or cystitis. In addition to these affections, it is of service in pyelitis, urethral hæmorrhage, and bronchitis.

BENZOSULPHINIDE

For the Preparations of Benzosulphinide *see* p. 111.

Action and Therapeutics of Benzosulphinide

Benzosulphinide is an antiseptic, but as such of very limited use, because its properties in this direction are not marked. Its principal use is as a sweetening agent. It is not a food, but a condiment, and is eliminated in the urine and saliva without change.

It is quite generally employed as a **substitute for sugar** when from any cause, as in diabetes mellitus, or obesity, this cannot be taken. It may be used in tablets; for sweetening a cup of tea or coffee 1/10 gr., .006 gm., is sufficient. Inasmuch as this substance is largely excreted into the saliva, unless small amounts are used, a disagreeable taste in the mouth will be permanently established; and further it has been shown that it interferes with the secretion of ptyalin, pepsin and trypsin. It is believed to be harmful in daily amounts of over .30 gm. (5 gr.), but this amount is likely never to be reached even if taken with foods preserved by it. In many instances of gout, digestive and metabolic disturbances its use is preferable to sugar which is readily fermentable. It has been used as an internal antiseptic in **cystitis with ammoniacal urine**, and has been commended as a lotion in aphthous stomatitis and in ozena.

DIVISION VII.—DRUGS ACTING ON THE BODILY HEAT.

A. Antipyretics, or Drugs which decrease the Body Temperature.—With the exception of those which, when given in sufficient quantity to induce severe collapse, may in this way cause the temperature to fall below normal, there are few capable of reducing the temperature in health. The term antipyretic is therefore limited to such drugs as have the power of depressing the body temperature in fever. In health the temperature is maintained at a uniform point through a balance established between the production of heat (**thermogenesis**) and its dissipation (**thermolysis**) through the skin, lungs and other organs. The main source of production is the voluntary and invol-

untary contraction of the muscles, and the loss of heat occurs to some extent through the lungs, but chiefly by means of radiation from the cutaneous blood-vessels and the evaporation of perspiration. Now if an excessive formation of heat takes place, as during active muscular exertion, this is compensated for by an increased output from the skin, through the dilation of the vessels and by the perspiration. On the other hand, if there is an increased heat dissipation from exposure to cold, this is offset by an augmented combustion of the tissues, with the formation of more heat. In order to preserve a balance between the heat-producing and heat-dissipating agencies there must be present a coördinating mechanism, and there is considerable reason for locating this about the corpus striatum, in the basilar ganglia of the cerebrum. Lesions in this part of the brain are usually found to cause a very marked rise of temperature, and it is stated that in animals no shivering is produced by cold, after section of the cerebral peduncles. The heat regulating function (**thermotaxis**) is more or less deranged by various poisons, and especially by such as are generated in fever. The existence of a heat-regulating center in the brain, it may be stated, has never as yet been definitely proved, and some investigators believe that the vaso-motor center in the medulla oblongata is sufficient to explain the normal coördination of formation and output. It has lately been suggested that the thyroid and suprarenal glands, one of which is thought to be perhaps the main organ of the body to provide vaso-dilating material, while the other furnishes the chief supply of vaso-constricting material, may play an important part, by their opposed action, in this alternate opening and shutting of the blood-vessels. As affording some support to this view, attention has been called to the fact that in the infant, which apparently has no heat governor or regulator, since its temperature varies with that of its surroundings, the thyroid is but imperfectly developed, while the suprarenal glands have been observed to contain no vaso-constricting substance.

Drugs which increase the loss of heat.—Among these are included all sudorifics and dilators of the cutaneous blood-vessels. The action of **salicylic acid** and **salicin** in reducing temperature is probably explained by the vascular dilation caused and the increase in the output of heat. This is also now believed to be the fact with drugs of the class to which **acetanilid, antipyrine** and **acetphenetidin** belong. Some investigators, however, regard the fall in heat formation as too

great to be explained in this way, and infer that these antipyretics diminish the combustion through some other action, though not by affecting the tissues directly.

Drugs which probably diminish the production of heat.—**Quinine** apparently does this by lessening the metabolism. The antipyretic action of digitalis may perhaps be due to its causing an increased activity of the heat-regulating center, as has been shown to be the fact with central nervous stimulants. The fall of temperature produced by antimony has been explained by the slowness of the circulation and by the general depression and profuse perspiration. The precise manner in which aconite reduces the temperature is unknown. A cold bath not only abstracts heat, but if continued for a time may diminish its formation. Sometimes the removal of some reflex source of irritation may lower the temperature, and in this way purgatives occasionally act as antipyretics.

Therapeutics.—Alcohol, spirit of nitrous ether, antimony, ipecac and opium were formerly in constant use as antipyretics, but at present are not given for this purpose. Cold is more often employed, either by cold sponging, ice, or a cold bath. Sponging with hot water will, by the vascular dilatation and subsequent sweating it induces, reduce a febrile temperature.

Of the drugs which are now used for this purpose, acetanilid and antipyrine are dangerous because of the collapse they may bring about, while quinine and salicylic acid are rather uncertain, except in malarial and rheumatic fever respectively. Antipyrine is a very prompt and certain antipyretic, and, notwithstanding its danger, it and acetphenetidin are most in use. Acetphenetidin is less powerful, but quite safe, as a rule. Antipyretics, however, in sufficient doses to reduce the temperature may cause dangerous depression. Fever is only a surface indication of the essential pathological condition which is systemic infection, and if the pyrexia is not excessive, no special action is called for. When this is the condition the external use of cold is generally preferable, since in addition to its antipyretic effect, it is likely to furnish a needed stimulus to the nervous system and prove beneficial in other ways.

B. Drugs which cause a rise of Temperature.—Belladonna may have this effect. The cause is not definitely known, but it has been attributed to direct action on the heat centers in the brain. The temperature is generally increased by large doses of cocaine especially

in *habitués;* it is thought probable, from some disorder of the cerebral heat-regulating centers. In these patients often very slight causes will produce an inordinate rise of temperature. Caffeine and strychnine increase the body heat to some extent.

Tuberculin, various albumoses, and animal poisons, such as those of various shell-fish, will cause a rise of temperature. Their mode of action is unknown.

The Antipyretics

ACETANILID

For the Preparation of Acetanilid *see* p. 110.

Action of Acetanilid

External.—It is antiseptic, **analgesic** and slightly sedative to the nervous system.

Internal.—*Blood.*—In the red corpuscles it causes the formation of methæmoglobin, and, in larger amounts, a disintegration of the corpuscles. The movements of the leucocytes are also arrested by it. The action on the blood is decidedly weaker than is the fact with phenol and other similar agents, but it occasions a peculiar **cyanosis,** which is much more intense than that caused by the formation of the same amount of methæmoglobin by other poisons, often accompanied by dyspnœa and acceleration of the pulse, and which may last for several days, or even weeks after the remedy has been withdrawn.

Heart and Vessels.—The heart is at first accelerated and afterwards slowed, and this is attributed to the direct action of the drug upon the cardiac muscle. When a considerable reduction in temperature is caused, this also contributes largely to the slowing of the organ. The increased rate of the heart leads to a slight rise in the blood-pressure, but this falls as the pulse becomes slower.

Respiration.—This is not usually affected by ordinary doses, but under poisonous amounts it progressively fails.

Kidneys.—Acetanilid has some diuretic effect. Some consider it probable that in large doses it increases the excretion of uric acid, but others state that in health it has no effect on the excretion of this substance. After ordinary doses the urea and total nitrogen of the urine may be slightly augmented, and in large amounts it causes an ncrease in these of 30 per cent., so that there is a large increase in the

tissue waste. Acetanilid is rapidly absorbed, undergoes a partial oxidation, but, except after very large doses, none appears in the urine. Some of it enters into combinations with sulphuric and glycuronic acids, and the oxidation products often give a smoky color to the urine, especially after it has been exposed to the air for some time. After large doses the color of the urine may also be darkened in consequence of the presence of **methæmoglobin.**

Skin.—Diaphoresis may be produced in consequence of the increased cutaneous circulation, and in fever, profuse sweating not infrequently follows its use. Sometimes an erythematous rash is caused, which usually resembles that of measles, occasionally urticaria occurs, and more rarely eczema and bullæ, while in some instances an œdematous swelling is observed. Such skin affections, which are less frequently elicited by acetanilid than by antipyrine, may possibly be accompanied by some febrile reaction.

Temperature.—Acetanilid has little effect upon the normal temperature, but if it is above normal, however, it has a marked **antipyretic** effect, often reducing it to below normal. It was at one time supposed that acetanilid and other drugs of its class diminished the heat production in consequence of lessening the metabolism, in the same way as quinine. It is now known, however, that such is not the fact, and it is held that the seat of their action is the base of the cerebrum. As to the *modus operandi* of these antipyretics, it is believed that they effect the reduction of pyrexia by central action, through alterations produced in the heat-regulating mechanism which result in lowering the point at which the temperature is maintained. Consequently, a great increase in the dissipation of heat must take place in order to get rid of the warmth that has accumulated in the body, and this augmented output is attained by dilatation of the cutaneous blood-vessels. Their principal action practically, therefore, is by causing an **increased heat loss** through this vascular effect, by reason of which a large amount of blood is exposed to the cold air. It has been shown experimentally that the dilatation of the cutaneous vessels is sufficiently marked to be recorded by the plethysmograph in many instances, while in others flushing of the skin is observed. There is also a lessened heat production, but this is found to be much less important, and is now generally regarded as due to the fact that, at the lower temperature produced, metabolism goes on less actively. The decrease in metabolism is really, then, an

effect, and not a cause, of the fall of temperature. The degree of antipyretic action produced by these drugs is thought to depend to a great extent on the functional activity present in the centers, as it is found that there is a difference in the susceptibility of different fevers to the action of such agents; high continuous fevers reacting least, and those of an intermittent type being most amenable. Acetanilid, and its group, therefore, possesses **antiperiodic properties**, and in malarial fever the greatest effect is produced when the action falls in the period of the natural decline of temperature.

Nervous System.—The action on the central nervous system, aside from that on the heat-regulating center, consists in stimulation followed by paralysis, and a narcotic, a convulsant, and a collapse effect, which pass insensibly into each other, have been described. Its narcotic action renders acetanilid a powerful **analgesic**, although the narcosis is not at all comparable to that of the true narcotics, since cerebral effects may be induced by small doses which do not apparently influence the mental activity. As the influence of ordinary doses upon the nerve cells appears to be very slight, it has been suggested that the action may perhaps be confined to some special areas of the brain. The convulsions produced by large doses are stated to be intermittent in character and preceded by increased reflex irritability, but the origin of the convulsions is not clearly understood. In general, they appear to be referable to the cerebrum, but it is possible that in some instances they may not be due to the direct action of the poison on the brain, but are rather asphyxial in character and dependent upon the changes in the blood, circulation and respiration. In ordinary poisoning the peripheral nerves and nerve ends do not seem to be seriously involved, and the final paralysis is considered to be undoubtedly central. The convulsive stage is followed by unconsciousness, collapse, and total paralysis. The pulse, at first accelerated, becomes slowed, and the respiration is dyspnœic and then diminished. The skin is cyanotic and covered with cold sweat, and sometimes there are vomiting and dilatation of the pupils. Symptoms of collapse are occasionally produced in susceptible persons by medicinal doses, and especially if these are large, though death has been known to occur after only .30 gm. (5 gr.) in one instance; possibly the drug may have been impure. In the milder instances the skin is cool and the pulse rather small and rapid, and the condition soon passes off. In severe ones the skin is cold and covered with

a clammy sweat which is diminished by the use of atropine, the heart is weak, irregular, and sometimes fluttering, and the body temperature may be subnormal. The weakness of the heart is the principal source of danger, and the total failure of the circulation seems to be the cause of death. Collapse occurs more frequently when a rapid fall of temperature has been produced, that is to say when an unnecessary amount of the drug has been given, than under other circumstances, but may be observed in persons who have had no fever. The collapse sometimes appearing after small doses in fever, it has been suggested, may be due, not to the drug, but to the reduction of the temperature. In such instances, there may have been a pre-existing collapse, which was masked by the hyperpyrexia, the effects of which are in certain ways antagonistic to those of collapse. When, therefore, the stimulus of the high temperature is removed, the collapse becomes apparent. Notwithstanding its insolubility, acetanilid is said to have been absorbed from wounds in sufficient amount to produce toxic symptoms.

Untoward Action.—In addition to the collapse, the cutaneous eruptions and the cyanosis which occasionally follow medicinal doses, there may be mentioned certain other untoward effects: digestive disturbances, symptoms resembling cinchonism, and paroxysms of sneezing. Under prolonged use of the drug, congestion of the liver, spleen and kidneys is said to occur.

Therapeutics of Acetanilid

External.—Acetanilid has been used with advantage as a dusting powder for venereal ulcerations, and as an **antiseptic** for wounds. Too large a surface, however, should not be covered.

Internal.—*Pyrexia.*—Acetanilid was originally introduced on account of its powerful **antipyretic** action in fever, and it is still used to some extent for this purpose. The opinion is gaining ground, however, that if the temperature is not very high no attempt should be made to reduce it, as there is then no danger from this source, and, moreover, the theory is still held by some that fever is a defensive measure taken by the organism against the causes of disease. The principal objection to the use of acetanilid and other similar drugs is the cardiac depression which they are liable to induce, and hence in exhausting diseases like the continued fevers they may prove distinctly dangerous. In order to obviate this strychnine should always

be administered. Most physicians, therefore, deem it preferable to use cold baths or some of the modifications of the Currie-Jürgensen treatment (*see* p. 566) whenever the temperature reaches such a point that the hyperpyrexia is dangerous to life. If it is decided to use antipyretics, acetanilid will often produce a rapid reduction of temperature. The minimum is reached in about two hours, and the effect may continue for a considerable time. This action does not persist after the drug is excreted, however, and hence the administration must be at reasonably short intervals in order to produce a continuous effect, although if it is given when the fever is just beginning to rise again, smaller doses are required than at first. Of the more usual antipyretics, acetanilid produces probably the strongest collapse effects, and it is found not to have so lasting an effect upon the temperature as some other remedies of its class. As it has no direct action upon the intestinal tract, it may be administered by the rectum when this seems desirable.

Analgesic Action.—Acetanilid is frequently useful in relieving the pain in conditions not accompanied by fever as that of neuralgia, sciatica, dysmenorrhœa, locomotor ataxia, migraine, and various headaches. It has been employed to mitigate nervous excitability in hysteria and other emotional manifestations. Like the other antipyretics, it is largely employed in the treatment of influenza.

TOXICOLOGY

When symptoms such as cyanosis, dyspnœa, and a failing heart resulting in collapse are caused by acetanilid the treatment consists in stimulation, as in collapse from other causes. General stimulation is called for by alcohol and ether, given subcutaneously or by the mouth, or in both ways, and stimulation of the heart by the subcutaneous injection of strychnine. Oxygen inhalations may also be of service, and hot applications should be made to the extremities and body. Persons making habitual use of acetanilid are likely to suffer from digestive disturbances, neuralgias, even neuritis, various rashes or erythema, urticaria or eczema, and cardiac weakness showing itself by palpitation and dyspnœa upon even slight exertion.

ANTIPYRINE

For the Preparation of Antipyrine *see* p. 112.

Action of Antipyrine

Antipyrine is **hæmostatic**, having the property of coagulating proteids, causing a shrinking of mucous membranes, and a lessening

of pain. When locally applied, it is a local **anæsthetic,** in 25 per cent. solution, but irritation has followed its hypodermatic use. It may produce an erythematous or other rash. It may moderately increase arterial pressure, in small doses, by direct stimulation of the heart; in large doses it is a cardiac depressant, the final fall of blood-pressure being certainly due, at least in part, to a direct action upon the heart. Like acetanilid, it is somewhat diuretic, and it is excreted in great part unchanged in combination with sulphuric acid and perhaps with glycuronic acid. It does not cause either a destruction of red cells nor a formation of methæmoglobin in the blood. It rapidly reduces an elevated temperature in the same way as does acetanilid. In large doses it is said to produce convulsions; later, coma and paralysis of motor nerves and muscles.

Therapeutics of Antipyrine

Antipyrine is given internally as a **powerful antipyretic,** in fevers of various kinds. It is also used as a hæmostatic in hæmorrhoids and epistaxis, and as an **analgesic,** when applied locally, in tuberculous laryngitis. It has been given with some success in diabetes mellitus and insipidus. It is largely employed as an **anti-neuralgic,** relieving the pains of locomotor ataxia and other nervous affections, and it has been highly recommended as a sedative in chorea, whooping cough and epilepsy. As an **anti-rheumatic** it is not alone effective, but administered contemporaneously with the salicylates is more satisfactory than either when given singly.

TOXICOLOGY

Antipyrine has been credited with a considerable number of deaths, but it is quite likely that most of them have been due to improper dosage. While antipyrine is somewhat less liable to toxic action, it occasionally produces collapse in the same way as does acetanilid. The treatment of the depression caused by it is the same as when produced by the latter (*see* p. 588).

ACETPHENETIDIN

For the Preparation of Acetphenetidin *see* p. 110.

Action of Acetphenetidin

Acetphenetidin has no action externally, nor on the gastro-intestinal tract, and with ordinary doses the blood is unaffected. It

slightly depresses the heart, but does not, in ordinary doses, affect the respiration. It is a mild diuretic, and large doses cause the passage of altered blood. It is a **powerful antipyretic,** by increasing heat dissipation and also diminishing heat production to some extent. It is likewise a powerful **analgesic.**

Therapeutics of Acetphenetidin

It is a valuable remedy for **reducing fever,** and because it depresses the heart but little, it is **safer** than either antipyrine or acetanilid. It is, however, very insoluble, and slower and less powerful than these remedies, though its effects last longer. Since it possesses a very marked **analgesic** action, acetphenetidin is to be preferred as a remedy for the relief of pain, as in neuralgia, sciatica, locomotor ataxia, migraine and various headaches. For this purpose, it should be administered every hour for three or four hours; when relief generally results. This drug has been of service in the treatment of epilepsy.

TOXICOLOGY

Acetphenetidin sometimes, but very rarely, produces severe vomiting, sweating feeble and rapid pulse, and collapse. Alcoholic stimulation and strychnine hypodermatically are indicated. External warmth is important.

DIVISION VIII.—DRUGS ACTING ON THE RESPIRATION

The influences affecting the respiration are so numerous and varied that it is not always easy to determine the precise mode of action of any drug which produces an impression upon it. Thus, the respiratory center in the medulla, which is subject to direct or reflex influences from almost all the organs of the body, the movements of the respiratory muscles, or the circulatory mechanism influencing the respiration may be acted upon; or, again, alterations produced in the blood or in the air respired may affect the function. In therapeutics, however, the object is generally to remove the cause of or alleviate respiratory difficulty, rather than act upon the respiration itself. Drugs which produce changes in the blood and circulation have already been considered, while for the consideration of such modifica-

tions of the temperature, moisture and atmospheric pressure as are of service reference must be made to treatises on general therapeutics. Therefore, the respiratory drugs will now be treated of under the following heads:

A. Drugs altering the Composition of the Air Inhaled.—These are drugs which, when inhaled, have some direct effect on the respiratory mucous membrane, or on the bronchial and pulmonary contents, and may also have remote effects. Certain drugs, although they are not employed for their effects on the respiration, are most conveniently administered by inhalation; *e.g.*, anæsthetics, oxygen and amyl nitrite.

Some drugs when inhaled produce very marked **irritation** of the bronchial mucous membrane, thus giving rise to vascular dilatation and augmented secretion, and reflexly causing cough from stimulation of the sensory nerves of the part.

Such are iodine, bromine, chlorine, senega, ipecac, nitric acid fumes, and ammonia. These are rarely used therapeutically as inhalations, and their inhalation is to be particularly avoided in irritable conditions of the bronchi.

Some drugs, when inhaled, are **soothing,** to the bronchial mucous membrane.

Hydrocyanic acid, is such a drug but is rarely employed, if ever, in this way.

Inhalations which are used to **stimulate** the bronchi, that is to say, to increase their vascularity, secretion, and muscular power, are—

(1) **Phenol.**
(2) **Oil of cajuput.**
(3) **Compound tincture of benzoin.**
(4) **Creosote.**
(5) **Oil of cubeb.**
(6) **Spirit of camphor.**

Of the first two 1.20 mils (20 ♏), of the others 15 mils (fl ℥ss) should be added to 500 mils (1 pt.) of water at 60°C. (140°F.).

Inhalations which are used to **disinfect foul secretions** from the bronchial mucous membrane are those of—

(1) **Creosote.**
(2) **Solutions of iodoform.**
(3) **Solutions of benzoin.**
(4) **Solutions of phenol.**
(5) **Oil of juniper.**
(6) **Oil of cubeb.**
(7) **Oil of eucalyptus.**
(8) **Oil of tar.**

Inhalations for **relieving spasm** of the bronchial tubes are those of—

(1) **Stramonium** (by smoking).
(2) **Chloroform.**
(3) **Ether.**
(4) **Amyl nitrite.**

B. Drugs acting on the Respiratory Center.—If, when injected into the carotid artery, a drug produces a very prompt effect on respiration, it is concluded that it acts on the respiratory center. In order to determine whether the drug acts on the center, or on the vagal terminations in the lung, it is customary to divide the vagi and then observe whether it acts in the same way after, as before, the section.

Drugs which directly **stimulate** the respiratory center are—

(1) **Ammonia** (very powerful).
(2) **Strychnine.**
(3) **Apomorphine.**
(4) **Belladonna.**
(5) **Stramonium.**
(6) **Hyoscyamus.**

Drugs which **depress** the respiratory center are—

(1) **Physostigmine** (very powerful).
(2) **Hydrated chloral.**
(3) **Chloroform.**
(4) **Ether.**
(5) **Alcohol.**
(6) **Opium.**
(7) **Hydrocyanic acid.**
(8) **Codeine.**
(9) **Aconite.**
(10) **Veratrine.**
(11) **Caffeine.**
(12) **Gelsemium.**
(13) **Ipecac.**

Alcohol, ether, chloroform, caffeine, and quinine slightly excite, before they depress, the respiratory center.

Therapeutics.—Drugs exciting the respiratory center may be given, when there is any difficulty in respiration, for the purpose of increasing the force of the respiratory act; at the same time measures should be employed to remove the cause of the difficulty. They are, naturally, most frequently required in respiratory diseases, and especially bronchitis. Ammonia and apomorphine are very frequently prescribed for the reason that they are also powerful expectorants, and belladonna is applicable in instances of excessive bronchial secretion.

Drugs which depress the respiratory center are very seldom required for this action; but the center for the reflex act of coughing is in the immediate vicinity of the respiratory center, and **opium, morphine, codeine, hydrocyanic acid,** and **ipecac** are often very valuable in allaying the continual hacking cough frequently accompanying disease of the heart and lungs.

The drugs which relieve cough are very numerous, since this may be reflexly set up by irritation of so many peripheral parts and internal organs, such as the nose, throat, pharynx, ear, teeth, larynx, trachea,

bronchi, lungs, pleura, stomach, and liver; and consequently its successful treatment generally depends upon the removal of local irritation in any of these.

C. Drugs affecting the Bronchial Secretion.

(*a*) ***Those increasing it:***

(1) **Apomorphine.**
(2) **All alkalies, especially ammonium carbonate and other ammonium salts.**
(3) **Ipecac.**
(4) **Senega.**
(5) **Squill.**
(6) **Turpentine.**
(7) **Terebene.**
(8) **Camphor.**
(9) **Benzoin.**
(10) **Balsam of Peru.**
(11) **Balsam of Tolu.**
(12) **Antimony salts.**
(13) **Sulphur.**
(14) **Iodine.**
(15) **Pilocarpus.**
(16) **Many volatile oils.**

It is probable that volatile oils and substances containing them decrease the amount of bronchial secretion as a later effect.

(*b*) ***Those decreasing it:***

(1) **Acids.**
(2) **Belladonna.**
(3) **Stramonium.**
(4) **Hyoscyamus.**

Under some circumstances alkalies may decrease the secretion.

(*c*) ***Those disinfecting it:*** Drugs which, when inhaled, act in this way have already been mentioned. Copaiba, cubeb, eucalyptus, and many volatile oils are excreted partly by the bronchial mucous membrane, and thus will disinfect the secretion in this process.

Therapeutics.—In bronchitis, remedies which increase the secretion are used when the latter is so viscid that it adheres to the tubes and cannot be coughed up; and those which decrease it are employed to prevent its formation when it is too abundant to be easily expectorated. The purpose of disinfectants is evident.

D. Drugs relaxing Spasm of the Muscular Coat of the Bronchial Tubes, or Antispasmodics.—It is believed that the symptom known as asthma is due to a spasmodic contraction of the bronchial tubes, and as the following relieve this symptom, it is concluded that these drugs relax spasm of the muscular coat of the bronchial tubes.

(1) **Stramonium.**
(2) **Belladonna.**
(3) **Hyoscyamus.**
(4) **Grindelia.**
(5) **Aspidosperma.**
(6) **Lobelia.**
(7) **Chloroform.**
(8) **Ether.**

From their analogous action in other parts of the body, it is probable that the following drugs act in the same way: Opium, hydrated chloral, ether, cannabis and amyl nitrite.

Therapeutics.—Stramonium, the most powerful of these, is of great use for relief of the symptom asthma, and this and the other drugs may be employed for bronchitis in which spasm of the tubes seems to result from the inflammation present. Many of these muscular depressants in all probability depress the nerves at the same time.

E. Drugs acting on the Vessels of the Bronchi.—These are the same as have been already described (*see* p. 467) as acting on the vascular system generally.

F. Drugs which sometimes Produce Cheyne-Stokes Breathing.—These are morphine, potassium bromide, and hydrated chloral. In animals the following, in addition, may do it: digitalis, strychnine, and ammonium carbonate.

Expectorants.—On account of the complexity of the modes of action of drugs affecting the respiratory system, it is customary to regard most of them, clinically, simply as drugs which hinder or aid the expectoration of the contents of the bronchial tubes. Those which aid it are divided into two groups, named after their action, not on the lungs, but on the circulation.

1. *Stimulating expectorants.*—These are stimulants to the circulation generally. They are—

(1) **Acids.**
(2) **Ammonium salts.**
(3) **Senega.**
(4) **Squill.**
(5) **Benzoin.**
(6) **Benzoic acid.**
(7) **Balsam of Tolu.**
(8) **Storax.**
(9) **Turpentine.**
(10) **Terebene.**
(11) **Terpin hydrate.**
(12) **Sanguinaria.**
(13) **Eriodictyon.**

2. *Depressing expectorants.*—These depress the general circulation. They are—

(1) **Alkalies.**
(2) **Antimony salts.**
(3) **Ipecac.**
(4) **Aspidosperma.**
(5) **Lobelia.**
(6) **Pilocarpus.**
(7) **Apomorphine.**
(8) **Potassium iodide.**

Therapeutics.—It is difficult to formulate any general directions. In any patient before us we must consider the character of the disease and whether we wish to stimulate or to depress the circulation, to increase, to diminish or to disinfect the expectoration, to stimulate the respiratory center, to overcome spasm of the bronchial tubes, or to allay a hacking cough; and then employ such remedy or combination of remedies as seems best to meet the indications present.

Warmth to the chest and warm drinks are sedative, and increase the amount of secretion, while cold and cold drinks have an opposite effect.

Drugs Altering the Composition of the Air Inhaled

CREOSOTE

For the Preparations of Creosote *see* p. 158.

Action of Creosote

The action of creosote, externally and internally, is practically the same as that of phenol.

Therapeutics of Creosote

Before the introduction of phenol it was employed externally as a parasiticide, as well as an **antiseptic**, and internally to relieve vomiting and flatulence. It is superior to phenol as an antipruritic, but is not much used on account of its penetrating odor. When applied on cotton to the cavity, it is efficient in relieving the aching of a carious tooth. The most important use of creosote is as a pulmonary antiseptic, administered by the mouth, hypodermatically, or by inhalation. In **tuberculosis**, in which it often markedly improves the appetite and digestion and diminishes the fever and night sweating, it can be administered in the form of an emulsion with cod liver oil; or with the hypophosphites and cod liver oil; or with the syrup of wild cherry, or in a mixture of glycerin and whiskey. The dose of creosote should be gradually increased until 1.20 to 1.50 mils (20 to 25 ♏) are reached in the twenty-four hours. Administered in the form of enteric pills, which will dissolve only in the intestinal fluids, a daily dosage of 3.30 mils (50 ♏) can be reached without inconvenience. The method of hypodermatic injection in sterilized olive oil requires a special apparatus, is very tedious, painful, and altogether irksome to patient and physician. By inhalation, creosote is employed with equal parts of alcohol and spirit of chloroform, or in alcohol, 1 part to 8, in a perforated zinc inhaler, of which 1 mil (15 ♏) is placed upon cotton and used during fifteen minutes in every hour. Administered in this way it is useful in ozœna,

fœtid bronchitis, bronchiectasis and pulmonary gangrene. If the best beechwood creosote is employed, no untoward results are likely to be obtained. If the dose is increased too rapidly there may occur some nausea, epigastric uneasiness, and even vomiting. Disturbance of the kidneys has been produced, and the urine then presents practically the same appearances as after the ingestion of phenol (*see* p. 307). The gastric symptoms may be relieved by the patient's placing himself upon his back, for half an hour after administration of the remedy. It is quite likely that the patient acquires a tolerance, for the daily dose of 20 mils (300 ♏) has been given for a considerable time, with benefit, although 3.30 mils (50 ♏) should be considered as the maximum daily dose. If for any reason the treatment is suspended the commencing dose should be the minimum one. Creosote is more efficient than its principal constituent, guaiacol, even if given in proportionate dose.

Creosote carbonate is employed for the same purposes as creosote and is preferable for internal administration because it is less irritating to the alimentary tract and the renal disturbances are slight. The pharmacopœial dose may be largely exceeded and its use persisted in so long as is necessary. In **acute infectious pneumonia** daily amounts of 30 mils (1 fl. oz.) are well borne.

GUAIACOL

For the Preparations of Guaiacol *see* p. 158.

Action and Therapeutics of Guaiacol

Guaiacol is locally an **antiseptic** and its general action is similar to that of creosote, but it is less likely to irritate the intestinal canal and kidneys.

If painted on the skin over an area of from 10 to 50 sq. cm. (4 to 20 sq. in.), it is capable of **reducing pyrexia,** but it is not used for this purpose on account of the sweating and collapse which it occasions. It has been employed as a counter-irritant in epididymitis and tuberculous peritonitis. The carbonate, since it disturbs digestion less, is often employed as a substitute for guaiacol, and for prolonged administration, is preferable to it. Guaiacol carbonate has been used to a large extent in **pulmonary tuberculosis,** under the idea that

it has a destructive effect upon the bacilli of the disease; but there is no positive evidence that such is the case, although improvement in the general condition of the patient is often attained. It has also given excellent results in the treatment of **typhoid fever** and other fevers in limiting the decomposition in the intestines.

Drugs Acting on the Respiratory Center

HYDROCYANIC ACID

For the Preparations of Hydrocyanic Acid *see* p. 65.

Action of Hydrocyanic Acid

External.—Hydrocyanic acid is an active protoplasmic poison, and is toxic to all forms of life. The diluted acid, when applied to the unbroken skin, is at first slightly irritating, but, as it penetrates the epidermis, it soon causes paralysis of the sensory nerve-endings, and thus has an **anæsthetic** effect. It also produces a dermatitis on local application to the skin. From abraded surfaces it is rapidly absorbed and produces toxic effects. Silver cyanide acts as hydrocyanic acid.

Internal. *Alimentary Tract.*—Hydrocyanic acid is quickly absorbed by mucous membranes, and on the fauces, œsophagus and stomach the same **sedative** effects are produced as upon the skin.

Blood.—Under the influence of hydrocyanic acid the tissues are unable to absorb the oxygen brought to them by the blood cells; in consequence, the oxyhæmoglobin of the blood is not reduced in the capillaries, and the venous blood, therefore, has a bright red color. Lactic acid and sugar, which are always present when the oxidation of the tissues is imperfect, are found in the blood in unusually large quantities. In the body the acid does not enter into any combination with the hæmoglobin of the red corpuscles. Blood to which it has been added retains its red color much longer than ordinary blood, and it is thought by some observers that the reason for this is that the acid inhibits or destroys the oxidizing ferments in the blood, by which its oxygen is utilized in the cells. Whenever hydrocyanic acid and methæmoglobin come in contact, a combination is formed (**cyanomethæmoglobin**) which is distinguished from ordinary methæmoglobin by having a bright red color; and in instances of hydrocyanic acid poisoning the dependent parts of the body are often

found to present such a color in consequence of this action on the methæmoglobin which they contain after death. The blackness of the blood in the internal organs is believed to be simply the result of the rapid death, such as is met with after any sudden death in well-nourished persons; the tissues being still alive after the stoppage of the circulation, and using up all the oxygen contained in the blood.

Heart and Circulation.—The circulation is altered mainly through the action on the central nervous system, but the drug also acts directly on the heart. The pulse is apt to be slowed from the primary stimulation of the inhibitory centers, while the increased activity of the vaso-constrictor centers occasions a very considerable **rise** in **blood-pressure.** This central stimulation is succeeded by **paralysis,** in consequence of which the **blood-pressure falls** very low, but the movements of the heart generally remain slow, notwithstanding the cessation of the inhibitory stimulation, since the cardiac muscle is now directly affected by the depressing action of the drug. It is found that if very large quantities are inhaled, the heart may cease contracting for a few seconds, and then recommence a slow and feeble beat, which is quickly arrested again. This is thought to be due to primary action on the inhibitory center, followed by direct paralysis of the heart.

Respiration.—The respiratory changes are caused by primary stimulation and subsequent paralysis of the medullary center. After very large quantities the respiration may cease within a few seconds. Under the use of smaller doses it is rendered quicker and deeper, then becomes irregular, subsequently grows very slow and deep, and finally ceases.

Nervous System and Muscles.—The central nervous system is primarily stimulated and then depressed and **paralyzed,** and the medulla oblongata and lower portions of the brain are at first more profoundly affected than the cerebral cortex, although the final paralysis apparently includes all parts of the central axis. When the drug is given in doses small enough to permit of watching its action, it is found that this commences in the medulla, where the vaso-motor, respiratory, vagus, vomiting and pupil-dilator centers are all stimulated. Then unconsciousness results, and after this convulsions, which are believed to be chiefly medullary in origin. Finally, paralysis of the whole central nervous system ensues, and involuntary evacuations

of fæces, urine and semen are frequently observed. During the convulsions, which are rare in man, there is generally a temporary rise in blood-pressure, and the respiration is naturally very irregular. Death is due to arrest of the respiratory function, the heart continuing to beat for a short time. The phenomena of the action of hydrocyanic acid on the central nervous system, it will be seen, are very much like those of **asphyxia**, and it is regarded as probable that the latter plays an important part in their production, though the rapidity of their development indicates that they cannot be attributed entirely to asphyxia. The peripheral nerves and muscles, unless large amounts of the drug are injected, are not found to be much affected.

Excretion.—Hydrocyanic acid is rapidly decomposed in the body. Part of it combines with sulphur-containing molecules to form sulphocyanides, and is excreted as such in the urine, while part undergoes further changes which are as yet unknown.

Therapeutics of Hydrocyanic Acid

External.—Hydrocyanic acid is a valuable **antipruritic**. The official preparation should always be well diluted, and may be applied to allay itching from almost any cause. It should not be employed whenever the skin is broken.

Internal.—In small doses the diluted acid, on account of its sedative and **anæsthetic** effect, is often useful in relieving vomiting or gastric pain, and in many instances it may be administered most acceptably in an effervescing draught. Since the effect of the remedy is transient, it should be given at frequent intervals. It is sometimes employed with advantage to allay cerebral irritation and excitement. The giddiness of Ménière's disease (auditory nerve vertigo) is sometimes benefited by it, and it may prove useful in relieving the nervous palpitation met with in some instances of organic disease of the heart, and also attacks of palpitation occurring as a symptom of a nervous condition in patients not affected with cardiac disease. It is used as an ingredient of cough mixtures, or as syrup of wild cherry as a vehicle, on account of its effect in **dimishing reflex excitability** by reason of its depressing action on the central nervous system, and is especially valuable where there is a dry, hacking cough, without expectoration.

TOXICOLOGY

Symptoms.—The great danger from hydrocyanic acid is the great rapidity of its action. The patient falls insensible, and the eyes will be found fixed, glassy, and with widely dilated pupils, the limbs relaxed, the skin cold and clammy, the pulse so small as to be scarcely perceptible, and the respiration slow, deep, and convulsive. Death takes place, as noted above, from respiratory failure. When the poisonous quantity taken is smaller, there is at first an acrid, burning taste, which is accompanied by increased salivary secretion and followed by numbness of the mouth and throat. In the stomach there is a feeling of warmth, followed by nausea and vomiting. Other symptoms are headache, confusion, dyspnœa, slowness of the pulse, and great prostration, while the pupils are dilated and the eyeballs protrude. Soon unconsciousness supervenes, with or without convulsions, and then general paralysis, with involuntary defecation and micturition.

Post-mortem.—The characteristic odor of hydrocyanic acid is generally perceptible. The body is livid and the blood very dark. The heart is soft and flaccid and there is generally considerable congestion of the gastric mucous membrane. Post-mortem rigidity sets in very early, and the teeth are clinched, the fingers tightly closed, the toes strongly flexed, and the eyes prominent and staring.

Treatment.—In instances of poisoning by hydrocyanic acid the fatal result is usually produced so rapidly that the physician rarely has the opportunity of interfering. If life is not already extinct, the utmost promptitude is called for. The stomach should be washed out immediately, or vomiting should be induced by inserting the finger into the throat. Should this prove ineffectual, large doses of emetics must be given, as every moment is precious, and it is found that recovery is rapid when it has once set in. A 30 per cent. solution of hydrogen dioxide may be employed to wash out the stomach. The real element of danger is the stoppage of the heart, for although the respiration fails before this, respiratory paralysis can always be more or less successfully counteracted by artificial respiration, which is usually called for in poisoning by this drug. General stimulants, such as brandy or ether, given subcutaneously, are indicated, and ammonia, by inhalation, and caffeine may also be of service. Cold affusions, or alternately hot and cold, may be of assistance. Ferrous hydrate, when added to a cyanide salt forms a ferrocyanide almost instantaneously. Unfortunately, however, the strongly acid contents of the stomach greatly hinder the action of the ferrous hydrate, and hence alkalies must be added to neutralize the free hydrochloric acid; magnesium oxide is the best for this purpose. Another drawback is that the ferrocyanides are kept in solution with difficulty. As the result of these observations the following treatment is recommended: Have in readiness 30 mils (1 fl. oz.) of a 23 per cent. solution of ferrous sulphate; 30 mils (1 fl. oz.) of a 5 per cent. solution of caustic potash; 1.80 gm. (30 gr.) of powdered magnesium oxide; a metal receptacle of 500 mils (1 pt.) capacity; and a stomach-tube. The first two solutions should be kept in air-tight tubes, which can be broken into the receptacle. When poisoning occurs this is to be done, the powdered magnesia and 250 mils (½ pt.) of water is added, and the mixture shaken up and administered. This amount of antidote will take care of 6.50 gm. (75 gr.) of potassium

cyanide. As cyanide poisoning has become not infrequent among miners since the introduction of the cyanide process in the extraction of gold, it is advised that the antidote be kept in readiness for instant use, since time is the most important factor in securing a successful result.

WILD CHERRY

For the Preparations of Wild Cherry *see* p. 148.

Action and Therapeutics of Wild Cherry

Wild cherry is an aromatic bitter tonic. As hydrocyanic acid is set free when it is treated with water, its preparations possess more or less of the **sedative** action of that agent, and very large doses have a depressing influence upon the heart. The preparations of wild cherry have the same effect as hydrocyanic acid in relieving cough, by diminishing reflex excitability. The drug is sometimes a useful palliative in phthisis, where it may serve not only to alleviate the irritative cough, but also as a remedy for cardiac palpitation and gastric debility. The syrup is very largely employed as a vehicle for cough mixtures in general. Added to tincture of digitalis, it renders the latter less likely to produce gastric disturbance.

Drugs Affecting the Bronchial Secretion

APOMORPHINE HYDROCHLORIDE

For the Preparation of Apomorphine Hydrochloride *see* p. 118.

Action of Apomorphine Hydrochloride

External.—Apomorphine is said to have some anæsthetic effects on the cornea when a solution is dropped upon it.

Internal. *Gastro-intestinal Tract.*—Apomorphine is the **most powerful emetic** known. It is an indirect emetic, since its action is on the vomiting center in the medulla, and not a local one on the stomach, because the vomiting is produced more promptly, and with a smaller dose, if the drug is administered hypodermatically than when it is given by the mouth. It is shown even more positively by the fact that when injected subcutaneously it acts if the blood-vessels are ligated in such a way that none of it can reach the

stomach, while it does not act if they are so tied that none can reach the medulla. Moreover, no emesis is produced if apomorphine is placed in the stomach after the vessels supplying that organ have been ligated. Under the ordinary hypodermatic dose nausea usually occurs in man inside of fifteen minutes. The nausea generally disappears rapidly, but occasionally persists for some time, and may be accompanied by repetition of the vomiting. Collapse has been known to occur, but this is simply a result of the vomiting and not a direct effect, and it is usually not dangerous.

Heart and Circulation.—During the act of vomiting there is an in crease of pulse rate and of blood-pressure. The acceleration of the pulse, however, as well as the feeling of depression and muscular weakness present, is simply a result of the emetic action. Although in a few instances alarming collapse has been observed, no actual fatality is stated to have occurred from the use of the drug.

Respiration.—There is a quickening of respiration in consequence of the vomiting. If the amount of the drug is sufficiently large, its irritant effects are produced upon the rest of the central nervous system, as well as the vomiting center, and in consequence of this action also the respiration is accelerated. Physiological experiments show that apomorphine produces a **watery discharge from the blood-vessels of the respiratory mucous membrane,** which is found to be paler after the administration of this remedy, as well as less œdematous. This effect is produced within a half hour after ingestion, and it is not in any respect a phenomenon of the first stages of emesis. Large doses eventually depress the respiration.

Nervous System.—Its action on the central nervous system is shown first and mainly upon the **vomiting center,** so that the only direct effect of small doses is the production of the symptoms of emesis. In man small doses are said to be hypnotic, but this is not confirmed by observation.

Fate in the Body.—Apomorphine is not excreted into the stomach, like morphine, and it is stated that it has not been found in the mucous membranes of the air passages. It is possible that it may be decomposed in the tissues.

Therapeutics of Apomorphine Hydrochloride

Vomiting Action.—The advantages of apomorphine over other emetics are that it is **certain, prompt and energetic,** that it can be

given when emetics exhibited by the stomach would not act, and that it produces no gastric irritation. It is hence particularly valuable, administered subcutaneously, in instances of poisoning. Given by the mouth it is used to empty the stomach in acute indigestion and in alcoholism, to remove obstructions in the upper alimentary or respiratory tracts and occasionally to dislodge a gall-stone from the bile-ducts.

Expectorant Action.—It is, when given by the mouth, a **valuable expectorant.** In an adult, 0.002 gm. (1/32 gr.) will produce a watery expectoration within the time above stated, and this effect will last from two to three hours. It is especially useful in the early stages of acute bronchitis, in chronic dry bronchitis, in chronic catarrhal pneumonia, and in old tuberculous patients who are harassed by an unproductive cough. In larger doses it will relieve spasmodic conditions in the respiratory passages as croup or the symptom of asthma.

Soporific Action.—Recently it has been claimed that when given hypodermatically at bedtime, in the dose mentioned above, sleep, closely approaching the normal, ensues. For this purpose it has been employed in acute alcoholism and especially in delirium tremens. This is not by any means an established fact, and its hypnotic action may be due to contamination with other alkaloids.

IPECAC

For the Preparations of Ipecac *see* p. 144.

Action of Ipecac

External.—Ipecac powder is a powerful **irritant** to the skin, producing redness, vesication, and even pustulation and ulceration, when its application is prolonged. It is also irritant to mucous membranes, and some individuals are so susceptible to its local action that the opening of a jar of the drug at a distance of several feet will produce violent sneezing, irritation of the eyes, coughing, and other unpleasant symptoms. It possesses some antiseptic properties, being capable of destroying the bacilli of anthrax, though having no effect on the spores.

Internal. *Alimentary Canal.*—When taken by the mouth its irritant effect is exerted on the mucous membrane of the alimentary

canal, and in **small doses** it is a **stomachic**; producing moderate gastric hyperæmia and an increased flow of saliva and gastric juice, and thus aiding digestion. In **large doses** it is a powerful **emetic**, is due probably to a peripheral (gastric), and not to a central, action. Unlike apomorphine, which is known to **act** directly on the center, ipecac causes vomiting as quickly and with as small doses when it is given by the mouth as when administered hypodermatically; and the fact that its alkaloid, emetine, like many other irritants, has a specific action on the alimentary canal when injected subcutaneously would seem to satisfactorily explain the emetic action of the drug when given by this method. Some depression is produced by ipecac, simply as a result of the vomiting. If the dose is sufficiently large, and the most of it is not ejected in the emesis caused, the irritant effect of the drug is continued in the intestine, with the production of increased secretion and purging. It also has a **cholagogue** action, directly augmenting the biliary secretion.

Circulation and Nervous System.—When emetine is injected intravenously the cardiac effects are more pronounced than when it is given by the mouth or hypodermatically. After large amounts the central nervous system is acted upon. Paralytic symptoms are developed, and among the earliest in mammals is **vaso-motor paralysis** with **fall of blood-pressure.** Contributory to the production of the fall is weakening of the heart's action from the direct effect of the drug upon the cardiac muscle, and this results in death.

Respiration.—The respiratory movements are but little affected by moderate doses of ipecac, though as the result of the vomiting they may be somewhat quickened. The inhalation of the powder causes congestion of the **bronchial mucous membrane,** with **increased secretion,** and excites cough by reflex stimulation; and the same effect is produced by its excretion by this membrane of the drug when it is taken internally.

Skin.—Ipecac is in part excreted by the skin, and it acts as a **mild diaphoretic.** This cutaneous action resembles that produced by the application of warmth.

Therapeutics of Ipecac

External.—Ipecac has been used with success, as an antiseptic, in instances of anthrax. In the dermatitis caused by *rhus toxicodendron* a lotion of powdered ipecac in water, has been recommended.

Internal. *Alimentary Tract.*—Ipecac is quite generally employed as an emetic. It is contra-indicated in the very feeble and on account of the slowness of its action, should not be used for patients when as in poisoning, a prompt evacuation of the stomach is called for. Its chief use as an emetic is for clearing the passages in diseases of the respiratory organs, and in infants and young children particularly, it often acts very happily. In the domestic treatment of laryngismus stridulus an emetic dose of the syrup is the most usual remedy. Ipecac is also of service as an **emetic** when the stomach is to be relieved of undigested food, and attacks of acute indigestion, migraine, and the so-called bilious headache may sometimes be cut short by the vomiting caused by it. For emetic purposes a small dose 0.03 gm. (½ gr.) of tartar emetic is sometimes combined with it. In small doses, such as 0.015 gm. (¼ gr.) of the powder, ipecac is sometimes used as a stomachic, and, employed in this way, it may even serve to check vomiting. It has been known to arrest obstinate attacks of vomiting which had resisted all other treatment, and is one of the recognized methods of controlling the vomiting of pregnancy. Ipecac, 0.03 gm. (½ gr.), or more, combined with other cholagogues, has been found useful in instances of dyspepsia in which there is functional derangement of the liver, and in gastric ulcer, Dover's powder (*see* p. 115) is sometimes beneficial. One of the most important applications of the drug is in the treatment of dysentery. **Amœbic dysentery**, especially prevalent in tropical countries, is the form to which it seems best adapted, but it may sometimes be used with advantage in other varieties. In the severe attacks of tropical regions from 1.20 to 4.00 gm. (20 to 60 gr.) are usually given for the initial dose, and about 1.20 gm. (20 gr.) every four, six or eight hours afterward. It is considered important to establish tolerance of the remedy as soon as possible, and subsequent doses may be retained if the first one is rejected. In order to secure the retention of these large doses it may be combined with opium and aromatic powder, or other expedients may be resorted to. Milk is a good vehicle for the administration of ipecac, and in acute dysentery doses of 1 gm. (15 gr.), given in milk, are generally fairly well borne. Some advise doses of 2 gm. (30 gr.), without any liquid, at the onset, the ipecac to be preceded by a sedative dose of opium. Much of the danger of producing vomiting can be obviated by the use of pills which will not dissolve in the stomach. The good effects of the remedy have

been attributed by some to the large amount of tannic acid contained in the root, but its alkaloid emetine, administered as the hydrochloride, gives equally good results, in amounts to 0.13 gm. (2 gr.) daily. This can be administered hypodermatically in 0.03 gm. (½ gr.) doses. It is believed not only to cure the amœbic colitis but the resulting hepatitis as well and to prevent the abscess which frequently is produced in the liver by the amœbæ. In chronic dysentery ipecac is by no means so distinctly efficient as in acute, but in association with other remedies is often very valuable, although a longer time is required for a permanent cure. In bacillary dysentery the results are not usually encouraging. In other conditions of amœbic origin as **pyorrhœa alveolaris,** emetine has yielded equally brilliant results. In this condition it may be injected directly into the gums or given internally. If, however, a secondary infection of pyogenic bacteria has supervened, surgical interference is also necessary for complete cure. It is useful also in the summer complaint of infants and young children when the stools are of a greenish color and contain mucus or blood.

Respiratory Tract.—It is in general use as an **expectorant** in the form of the syrup. It not only increases the secretion of the bronchial mucous membrane, but also has the effect of rendering it more fluid and therefore less tenacious; while its property of exciting the act of coughing often adds to its usefulness. In children the syrup in doses of from 0.30 to 0.60 mil (5 to 10 ♏), is especially beneficial in the chronic bronchitis which remains after whooping-cough, measles or influenza, or is associated with chronic tonsillo-pharyngitis or adenoids. A general tonic treatment should also be maintained at the same time. In the treatment of acute bronchitis, ipecac is usually much more valuable in children than is the fact of adults. Its emetic properties sometimes render it useful in croup which is not of diphtheritic origin.

As a Diaphoretic.—Dover's powder (*see* p. 115) is an excellent **anodyne diaphoretic,** and is frequently given, in doses of 0.60 gm. (10 gr.) in chills and in the early stage of catarrh of the respiratory passages and of mild feverish attacks in general. In the intense suffering which sometimes results from the sudden suppression of menstruation it is often of great service in relieving pain and promoting diaphoresis. In acute rheumatism and other diseases where also it is desired to allay pain, and at the same time increase the action of

the skin, this powder may be administered in doses of 0.30 gm. (5 gr.) every two, three or four hours, according to circumstances.

As a Hæmostatic.—Ipecac has long been regarded as an internal **hæmostatic**, and it has been employed especially in hæmoptysis, hæmatemesis and uterine hæmorrhage. In hæmoptysis small doses, insufficient to produce vomiting, it is stated, serve to reduce the bleeding by decreasing the pulmonary congestion.

SENEGA

For the Preparations of Senega *see* p. 143.

Action of Senega

External.—Senega is **irritant** to the skin, when applied repeatedly, and to mucous membranes. When the powder is inhaled it causes hyperæmia and increased secretion in the respiratory passages, and excites violent sneezing and coughing.

Internal. *Alimentary Canal.*—When swallowed, its irritant effect on the mucous membrane induces increased secretion of saliva and gastric juice. In large doses it causes not only salivation, but more or less marked inflammation of the gastro-intestinal tract, with nausea, vomiting and purging.

Respiration.—Senega is a **stimulating expectorant.** When the drug is taken internally, senegin is excreted through the bronchial mucous membranes, with the result of producing vascular dilatation and augmented secretion and of reflexly exciting cough. It is on the respiratory passages that it appears to exert its most important influence.

Nervous System and Muscles.—When senegin, its glucoside, not official, is injected into the blood in moderate toxic quantities, the symptoms usually produced are principally intestinal, and fatal collapse from the changes in the alimentary canal occurs after the elapse of several days; but when large doses are used the central nervous system is most affected. At first there are violent convulsions, then paralysis, especially of the respiratory center, and the fatal result is very rapid. If the poison is applied directly to muscles or to nerve trunks, they lose their irritability at once, and even in dilute solutions muscle contracts more weakly, and eventually is not only paralyzed but structurally altered.

Kidneys.—Its glucoside is absorbed with difficulty, and is excreted by the kidney, as well as the bronchial mucous membrane, and also to some extent, it is said, by the skin. In the process of excretion it irritates the renal epithelium, and the drug therefore has diuretic properties.

Therapeutics of Senega

Senega is used now only as a **stimulating expectorant.** In subcute and chronic bronchitis it may prove useful in exciting an increased secretion of mucus and facilitating its expulsion from the respiratory passages. It should not be given in acute conditions on account of its irritant effect on mucous membranes, and for the same reason it is contra-indicated whenever gastric irritability or intestinal disorder is present. It is commonly prescribed in combination with other drugs in expectorant mixtures.

BALSAM OF TOLU

For the Preparations of Balsam of Tolu *see* p. 195.

Action and Therapeutics of Balsam of Tolu

In action is due chiefly to the benzoic acid which it contains.

It is used not only as an **expectorant** but, on account of its grateful taste, to flavor medicines, particularly cough mixtures, in which the syrup is frequently prescribed as a vehicle.

STORAX

For the Preparations of Storax *see* p. 195.

Action and Therapeutics of Storax

Its action is practically the same as that of the balsam of tolu.

Storax is a serviceable application to stimulate and disinfect ulcers. Internally it has been employed to some extent in the treatment of catarrhal affections of the genito-urinary organs, as for example, chronic gonorrhœa. At present its principal internal use is as an **expectorant** in the compound tincture of benzoin.

TEREBENE

For the Preparations of Terebene *see* p. 193.

Action and Therapeutics of Terebene

Its odor is more pleasant, but in other respects it for the most part closely resembles oil of turpentine. Like other volatile oils, it causes irritation of the lungs in the course of excretion, and therefore increases the bronchial secretion. It is likewise diuretic from the irritation of the kidneys excited during its excretion, and by its **antiseptic** properties it disinfects both the renal and bronchial secretions.

Externally it has been used successfully as a general antiseptic dressing for wounds, ulcers, burns, etc. Its most important use is as a **stimulating disinfectant expectorant**, and it is highly esteemed in chronic bronchitis, emphysema, winter cough of patients suffering from chronic bronchitis and even phthisis. Although it is said to form an insoluble compound with sugar, it seems to be efficient when given on a lump of sugar. A few drops taken in this way several times a day will not infrequently relieve a cough due to catarrhal bronchitis. It may also be given in capsules, in an emulsion, or in a mixture with other expectorants.

TERPIN HYDRATE

For the Preparations of Terpin Hydrate *see* p. 194.

Action and Therapeutics of Terpin Hydrate

Terpin hydrate is an antiseptic, and increases the secretion of the mucous membrane, and the functional activity of the kidneys.

It has been given as an **antiseptic expectorant** in acute and chronic bronchitis when the secretion is unusually free, in whooping-cough, and, rarely, in the treatment of chronic cystitis and gonorrhœa.

SANGUINARIA

For the Preparations of Sanguinaria *see* p. 144.

Action and Therapeutics of Sanguinaria

Sanguinaria in large doses is an acrid emetic; it is cautiously employed as an expectorant.

It is chiefly used, on the strength of its long-established reputation, as a stimulating **expectorant** in chronic bronchitis or in advanced stages of the acute disease.

ERIODICTYON

For the Preparations of Eriodictyon *see* p. 147.

Action and Therapeutics of Eriodictyon

Eriodictyon is a stimulating **expectorant** and possesses some antispasmodic action. The fluidextract is an excellent vehicle for quinine, concealing its bitter taste. It has been found useful in chronic bronchitis, particularly in combination with drugs of similar action. In asthmatic attacks the dried leaves have also been employed by smoking.

The Antispasmodics

GRINDELIA

For the Preparations of Grindelia *see* p. 196.

Action of Grindelia

Grindelia is excreted by the bronchial mucous membrane, as well as by the kidneys, and at first slightly increases the secretion of mucus, but afterward diminishes it. It appears to have a special action in **relaxing** the **muscular coat** of the **bronchi**, and this is said to be through depression of the ends of the motor fibers of the vagus distributed to the parts and of the reflex center in the medulla oblongata. The terminations of the sensory nerves supplying the bronchial mucous membrane are also said to be depressed. In the course of its elimination by the kidneys it excites more or less renal irritation, with increased urinary secretion.

Therapeutics of Grindelia

External.—In rhus poisoning speedy relief is often afforded by the application of cloths dipped in a mixture of the fluidextract with water. This may also be used to allay the pain of herpes zoster and

as a lotion for burns. One part of the fluidextract to four of water has been employed as a topical dressing in iritis, and diluted with glycerin this preparation makes a good application for chronic or irritable ulcers.

Internal.—On account of its property of relaxing the bronchial muscles, grindelia is one of the remedies most commonly resorted to for the relief of the symptom known as **asthma,** and three doses of 1.20 mils (20 ♏) of the fluidextract given every twenty minutes in milk, which prevents the precipitation of the resin, will often prove efficacious in arresting the paroxysms. Between the attacks this dose should be taken three times a day. Grindelia may also be combined advantageously with other asthmatic remedies, such as lobelia and belladonna. Moistened in a saturated solution of nitre and dried, the leaves are smoked in a pipe or burned upon a plate, so that the patient may inhale the fumes as they rise. The leaves prepared in this way, and with or without the addition of tobacco, lobelia, stramonium, etc., may also be rolled into cigarettes and smoked. The spasmodic difficulty of breathing which accompanies various pulmonary and cardiac diseases, hay-asthma, etc., is frequently benefited by grindelia. It is often of service in **subacute bronchitis,** chronic bronchitis, especially of the aged, emphysema and bronchorrhœa, and is usually prescribed in association with other expectorants. The bitter taste of the drug is best concealed by spirit of chloroform.

LOBELIA

For the Preparations of Lobelia *see* p. 146.

Action of Lobelia

External.—Lobelia is absorbed through the skin, but has no local action on it. The local application of the alkaloid lobeline, not official, to the eye is followed by contraction of the pupil, although in general poisoning by it, dilatation has been observed.

Internal.—*Gastro-intestinal Tract.*—Lobelia is a powerful **gastro-intestinal irritant.** Ordinarily, however, it produces violent vomiting without any action on the bowels, as most of it is expelled by the emesis, which is attended by extreme prostration. When the vomiting is insufficient to get rid of the poison it causes active purging, and **collapse is marked.**

Circulation.—In consequence of its action on the inhibitory apparatus of the heart, the pulse-rate is slowed at first, but afterwards is more or less accelerated. The blood-pressure, at first diminished, is afterwards increased beyond the normal. As a result of vomiting, however, marked variations in the rate of the heart and in the arterial tension are apt to be observed. In the collapse resulting from the gastro-intestinal irritation caused by lobelia the pulse is naturally small and weak.

Respiration.—Small doses stimulate and large doses paralyze the respiratory center, while the **vagus terminations** in the muscular coat of the bronchi or in ganglia in the lungs are also **paralyzed.** The respiratory movements may at first be much increased in rate and force. Later they become dyspnœic and asphyxia supervenes, death occurring from **respiratory failure.**

Nervous System.—Generally, coma and convulsions may be observed after poisonous amounts, but they would seem to be simply a result of the asphyxia. By some, however, these effects are regarded as due to a direct action on the higher cerebral centers.

Excretion.—Lobelia is apparently excreted by the kidneys and to some extent by the skin, and it is credited with a diuretic and diaphoretic action.

Therapeutics of Lobelia

External.—As an external application tincture of lobelia, with an equal quantity of glycerin, is a most useful remedy for the relief of pain in **acute epididymitis.**

Internal.—As it has the effect of relaxing bronchial muscle, the chief use of lobelia is for the relief of the symptom known as asthma. For this purpose the leaves may be incorporated with cubeb and stramonium, and smoked in a pipe during the attack. Or the smoke from the leaves or a combination with the same substances, burned upon a plate, may be inhaled. Tincture of lobelia is also employed to some extent as an **expectorant** in bronchitis, and especially when the latter is characterized by a **spasmodic element.** It is often combined with other antispasmodics and expectorants. In both bronchitis and asthmatic attacks its good effects are no doubt largely due to the free secretion of mucus which is produced by its nauseant action. The emetic dose of lobelia is very considerably larger than the expectorant dose, so that untoward vomiting is not readily

produced although small doses often cause nausea. It is, relatively, better borne by children than by adults.

ASPIDOSPERMA

For the Preparations of Aspidosperma *see* p. 146.

Action of Aspidosperma

It would seem that various alkaloids of this drug have different effects upon the organism and in some respects are more or less antagonistic to each other.

Circulation.—There is temporary fall of blood-pressure which may persist if the dose is large. This lowered blood-pressure is not due to paralysis of the vaso-motor system but, since the pulse is not slowed, it is probably due to a depressant effect upon the cardiac muscle.

Blood.—The blood in the veins as well as in the arteries is bright red in color, due probably to increased respiration because, if asphyxia supervenes, it becomes darker in all parts of the body.

Respiration.—Aspidosperma causes a marked **increase** in both **rate** and **depth of respiration**, the latter being especially pronounced. Lethal doses produce a depression which, however, is of brief duration. Intravenously it may produce intense congestion and ecchymoses in the lungs.

Therapeutics of Aspidosperma

It is a valuable remedy when the respiration is embarrassed in **emphysema**, chronic bronchitis or chronic pneumonia; it will relieve uræmic and possibly cardiac asthmatic symptoms. It is probable, however, that when **asthma** is not symptomatic of serious organic lesions, the effects of the remedy will be constant and satisfactory.

DIVISION IX.—DRUGS ACTING ON THE DIGESTIVE SYSTEM

A. Drugs acting on the Teeth.—For cleansing the teeth, powders are commonly used, but soaps, semi-liquid and liquid dentifrices are occasionally employed. Chalk, which acts mechanically, constitutes the basis of most tooth powders, and charcoal, which, however, may abrade the enamel, is also sometimes used for its mechanical effect. In order to prevent the decomposition of food lodged between the teeth, antiseptics, such as quinine, borax and phenol, are often used as ingredients of tooth-powders. Astringents such as kino are employed when the gums are inclined to bleed. As iron is apt to blacken the teeth and mineral acids and alum are injurious to them, it is advisable that these drugs should not be used as gargles for long periods, and that when prescribed internally they should be taken through a glass tube.

For the relief of toothache local anodynes such as creosote or phenol may be employed on absorbent cotton, which is inserted into the cavity of the carious tooth. There is some danger of damage to the dental pulp, and to prevent injury to the gums and mouth a pledget of plain, should be placed over the medicated, cotton.

B. Drugs acting on the Salivary Glands.—Drugs which increase the amount of saliva are called **Sialogogues**; those which diminish it, **Antisialogogues.** The saliva is derived from the secretion of the parotid, submaxillary and sublingual glands and the muciparous glandules of the buccal cavity, and the secretions produced by these different glands vary somewhat in their physical, properties, especially in the degree of their viscidity. The function of the submaxillary gland and the influences affecting it have been especially studied, and it is known that the gland is largely under the control of the chorda tympani nerve, some of whose fibers are of a vaso-dilator character, and thus secondarily influence the glandular secretion, while others affect the latter directly. This nerve, which has its center in the medulla, may be reflexly excited by stimulation of various nerves, and particularly the gastric branches of the vagus and the lingual and buccal terminations of the glosso-pharyngeal and gustatory nerves. The gland has also a nerve-supply from branches of the

cervical sympathetic trunk which are vaso-constrictor in character. The secretion of saliva appears to occur only when impulses reach the gland cells through the chorda tympani or through the cervical sympathetic fibers.

1. *Sialogogues acting either on the secretory cells or upon the terminations of the nerves in them.*—Of these, pilocarpus has been the most carefully investigated, and it has been shown that it acts on the terminations of the secretory nerves—the minute fibrils which ramify between the epithelial cells and perhaps even enter them. It is found that its action is not at all interfered with by section of all the nerves supplying the maxillary glands; also that it acts when injected directly into the gland but is prevented from entering the general circulation. When pilocarpus has been administered, the effect, which stimulation of the chorda tympani or of the sympathetic produces, is only such as can be readily explained by the vascular effects.

Sialogogues belonging to this class are—

(1) **Pilocarpus.**
(2) **Iodine.**
(3) **Mercury.**
(4) **Physostigmine.**

The last two probably act also by stimulating the medullary center, for section of the chorda tympani markedly lessens the secretion. Physostigmine also soon tightly contracts the vessels of the gland, thus checking secretion.

2. *Silalogogues acting reflexly by stimulating the peripheral ends of afferent nerves.*—Of these there are two varieties:

(*a*) Those stimulating the gustatory and glosso-pharyngeal nerves in the mouth

(1) **All Acids** and **Acid salts.**
(2) **Chloroform.**
(3) **Alcohol.**
(4) **Ether.**
(5) **All pungent substances,** as pyrethrum, mustard, ginger, etc.

(*b*) Those stimulating the vagus in the stomach:
Most emetics, particularly **Antimony** and **Ipecac.**

3. *Antisialogogues acting either on the secreting cells or the terminations of the nerves in them.*—Atropine acts directly on the gland as is shown by the fact that it prevents any increase of salivary secretion on stimulation of the chorda, although the vessels dilate as usual. It appears to act on the terminations of nerve fibers in the gland cells but this action is limited to certain definite terminations, since the sympathetic secretory nerve fibers are not paralyzed, and it has been ascertained that not all the fibers of the chorda tympani are acted

upon. Atropine would seem, then, to act upon the terminations of the secretory fibers, and to leave all others unaffected.

Antisialogogues falling under this heading are—
(1) **Belladonna,** (2) **Hyoscyamus,** (3) **Stramonium** and their alkaloids.

4. *Antisialogogues acting reflexly by depressing the peripheral ends of afferent nerves.*—Such are alkalies, opium, and any substances diminishing irritation of the mouth. Opium also has a depressing action on the medullary center.

Therapeutics.—A deficiency in the amount of saliva secreted is a prominent feature of belladonna poisoning, although it is most commonly met with in fevers, the mouth becoming extremely dry and the patient suffering from thirst. Remedies which relieve this and impart a sensation of coolness are known as **Refrigerants.** In fever acid drinks, such as lemonade, and beverages containing carbon dioxide gas are of service as sialogogues. For the condition known as "dry mouth" which is probably of nervous origin, pilocarpus has been employed, and this is also useful in relieving the dryness caused by belladonna or its alkaloid. Excessive salivary secretion is seldom met with except as a symptom of poisoning by such drugs as mercury, iodine and pilocarpus. In some forms of indigestion the saliva acquires a very disagreeable taste, or perhaps the secretion may become diminished; but here the correction of the difficulty is to be sought in the improvement of the digestion.

C. Drugs acting on the Stomach.—In the present state of our knowledge it is not possible to speak with accuracy of the special action of many of the drugs affecting the stomach, and it will therefore serve the most useful purpose to divide this class of drugs into those affecting the secretion of gastric juice as a whole, the secreted contents, the vessels, nerves, and movements of the stomach, and, lastly, those which are emetics.

1. *Drugs increasing the amount of gastric juice secreted.*—These are usually called **Stomachics,** and they include a large variety of agents. The secretion of gastric juice is reflexly augmented by all bitter and aromatic substances, which likewise increase the appetite, as well as by stimulants to the mouth. Indeed, the smell and sight of food constitute the most powerful stimulant to gastric secretion, and substances of agreeable flavor cause a marked increase in it by reflexes from the mouth and nose. The simple presence of food in

the stomach also tends to promote the flow. The aromatics appear, like other volatile oils, to cause an irritation, hyperæmia and increased secretion and peristalsis, with consequent improvement in digestion and absorption. It is thought probable, though this has not been proved, that bitters cause an irritation, leading reflexly to the same results. Their effects are, however, no doubt largely due to their taste, which is very lasting.

The drugs which increase the flow of gastric juice are—

(1) **Aromatics.**
(2) **Bitters.**
(3) **Alcohol.**
(4) **Ether.**
(5) **Chloroform.**
(6) **Pungent substances,** generally.

Therapeutics.—Stomachics are extensively employed to favorably modify the digestive process in various functional disorders.

2. *Drugs decreasing the amount of gastric juice secreted.*

(1) **Mineral** acids.
(2) **Acetic** acid.
(3) **Alcohol, Ether** and **Chloroform,** in large doses.

Therapeutics.—These drugs, however, are never given for this purpose. It should be noted here that acids and alkalies have opposite effects as regards the gastric juice and the saliva. While acids diminish the secretion of the gastric juice, which is acid, they increase that of the saliva, which is alkaline; alkalies, on the other hand, diminish the secretion of the alkaline saliva, but increase that of the acid gastric juice.

3. *Drugs altering the composition of the gastric contents.*—The reaction of the gastric contents may, of course, be modified by acids and alkalies. In instances of difficult digestion due to a deficient secretion of hydrochloric acid, diluted mineral acids are often prescribed, and they should be taken about two hours after eating, so as not to interfere with the secretion of the natural acid. If, on the other hand, there appears to be an excess of acid in the stomach, alkalies are ordered at meal times, and sodium bicarbonate is the one generally selected, although either the heavy or light magnesium oxide is preferable. When it is thought that secretion of pepsin is at fault, this is administered, and it is customary to prescribe it with diluted hydrochloric acid. In order to prevent fermentation and putrefaction in the stomach, **antiseptics** are employed. In all varieties of indigestion it should be borne in mind that it is of much greater im-

portance to remove the primary cause of the trouble than to endeavor to modify the composition of the gastric contents.

Drugs which have been used for this purpose are—

(1) **Phenol.**
(2) **Iodoform.**
(3) **Boric acid.**
(4) **Creosote.**
(5) **Eucalyptus.**
(6) **Thymol.**
(7) **Resorcinol.**
(8) **Salicin.**
(9) **Bismuth subsalicylate.**
(10) **Phenyl salicylate.**
(11) **Sodium phenolsulphonate.**
(12) **Naphthol.**
(13) **Charcoal.**

Moist charcoal has been considered by many to be useless, but it has been shown that it is capable of absorbing the gases from decomposing matter almost as readily as when dry.

4. *Drugs which dilate the vessels of the stomach.*—The vascularity of the stomach is very readily affected. Thus, mechanical irritation, such as results from the presence of food, and particularly peptones, causes a considerable dilatation of the vessels. Such increased vascularity, if not excessive, is advantageous, since it tends to promote absorption, as well as gastric secretion. The substances which increase the vascularity of the stomach are: all stomachics, excepting alkalies, diluted mineral acids, the drugs which have been already enumerated as irritants generally, and squill, digitalis, colchicum, senega, copaiba, gamboge, guaiac and veratrine. Most of these, however, produce, even in small doses, too powerful an irritant effect to be of service in this regard, and practically the only class of drugs, much employed to increase gastric vascularity, is the stomachics. Even these may induce gastritis, if used to excess, as is constantly seen in the case of alcoholics.

Gastro-intestinal irritants.—It will be found that in the description of the action of drugs a large number are designated as gastro-intestinal irritants. Caustic potash and mineral acids such as nitric and sulphuric acids are very powerful agents of this class. There is naturally a great variation in the severity of the effects of different gastro-intestinal irritants, and it is worthy of note that many of them have no action on the mouth.

5. *Drugs which contract the gastric vessels.*—These have already been mentioned as being generally astringent. As they are much more frequently employed for intestinal disorders, than for those of the stomach, they are considered later (*see* p. 626).

6. *Drugs acting on the nerves of the stomach.*—The terminal branches of both pneumogastric nerves, which supply the stomach, are markedly affected by all powerful gastric irritants, with the causation of severe pain; while drugs which are only mildly irritant to the stomach give rise merely to a sensation of warmth, which is often agreeable, rather than otherwise. It is, of course, never desirable to produce gastric pain.

Gastric Sedatives.—These drugs are also local sedatives to other parts of the body. Those most employed for the stomach are—

(1) **Bismuth subcarbonate.**
(2) **Bismuth subnitrate.**
(3) **Bismuth subsalicylate.**
(4) **Opium.**
(5) **Hydrocyanic acid.**
(6) **Belladonna.**
(7) **Hyoscyamus.**
(8) **Stramonium.**

Carbon dioxide, which has a similar effect, is used in the form of effervescing beverages.

They are most useful in the various painful forms of dyspepsia.

7. *Drugs acting on the movements of the stomach.*—As it has been noted that the movements of the stomach increase proportionately with an increased acidity of the gastric contents, it would appear that anything which causes an increase of acidity will tend to produce more pronounced movements. In addition, stomachics seem to promote the movements, while strychnine has been thought to directly stimulate the unstriped muscle of the gastric wall. Many, however, believe that the latter has no such specific action, but affects the digestion merely in the same way as the simple bitters. Under this class of drugs we have, then, mineral acids, stomachics, and nux vomica, and as an adequate amount of gastric movement is essential to the digestive process, they are of great value in the treatment of dyspepsia.

Carminatives.—This term is usually applied to substances which promote the expulsion of gas from the stomach and intestine by increasing peristalsis, stimulating the circulation, and perhaps relaxing the two orifices of the stomach. Many of them are also antiseptics. The most efficient are—

(1) **Stomachics generally.**
(2) **Aromatics especially.**
(3) **Bitters.**
(4) **Pungent substances.**
(5) **Valerian.**
(6) **Asafetida.**
(7) **Camphor.**
(8) **Volatile oils.**

8. *Emetics.*—The act of vomiting is a reflex one, and is controlled by the nerve center in the medulla which is situated near and closely related to the respiratory center. This may respond to afferent impulses reaching it from many organs, as the cerebrum, through the special senses, the various parts of the alimentary canal, the gall bladder, the genito-urinary tract, etc. Disturbance of the mechanism of equilibrium, as in vertigo and seasickness, is also a common cause of vomiting. Numerous drugs which, by their action on special organs, are capable of reflexly stimulating the vomiting center might be included among emetics, but it is customary to limit this designation to those which produce vomiting either by acting on the stomach or on the medullary center. The first class are sometimes called **direct** emetics, and the second, **indirect** emetics, but as certain authors use these terms in just the opposite way, making the direct emetics, those which act on the center, it will be more satisfactory to divide emetics into gastric, or local, and central, or general. The following experiments have been employed to determine the mode of action of the different emetics:

1. If when the drug has been injected directly into the circulation, preferably into the carotid artery, on account of its nearness to the medulla, it is found that vomiting results very promptly, it is concluded that the action is on the center. If, however, a considerable time elapses between the injection and the production of vomiting, the conclusion is reached that the action is on the stomach and that the drug must have been excreted into this organ before vomiting could be caused.

2. If the smallest amount of the drug which is capable of causing vomiting when injected into the circulation is larger than is required when it is introduced directly into the stomach, it is concluded that the primary action is on the stomach and that such vomiting as follows its injection into the circulation is due to the fact that a portion of the drug has been excreted into the stomach.

3. If when the stomach has been replaced by a bladder no vomiting results from its injection into the circulation, it is concluded that the drug acts on the stomach; but if vomiting takes place under these circumstances, the inference is that the action is on the center, the vomiting being caused by the contraction of the abdominal muscles.

4. If, when the drug has been introduced into the stomach, a long

time elapses before vomiting is produced, it is concluded that the action is on the center, the delay being due to the time required for the absorption of the drug.

It has been found, however, that such experiments are not altogether reliable, since some emetics act both locally and centrally, and, moreover, some of them, in the course of their circulation through the blood, probably act on some of the numerous organs from which impulses are transmitted to the vomiting center.

The following are the emetics most commonly used:

Emetics acting on the stomach:

(1) **Alum.**
(2) **Ammonium carbonate.**
(3) **Copper sulphate.**
(4) **Zinc sulphate.**
(5) **Sodium chloride.**
(6) **Ipecac.**
(7) **Mustard.**
(8) **Warm water.**

Ipecac has often been classed among emetics which act on the vomiting center, but it has been demonstrated that it has a direct action on the stomach.

Emetics acting on the medullary center:

(1) **Apomorphine hydrochloride.**
(2) **Antimony and Potassium tartrate.**
(3) **Senega.**
(4) **Squill.**

Apomorphine hydrochloride and antimony and potassium tartrate are very powerful, and much more depressant than the ordinary local emetics. The latter, like ipecac, however, also acts locally on the stomach, and the vomiting caused by it is largely due to gastric irritation.

Therapeutics.—Emetics are employed for three purposes: (1) To evacuate the stomach; important in most cases of poisoning. In many instances, however, washing out the stomach is preferable to the use of an emetic. Emetics, as apomorphine, given subcutaneously, sometimes aid the expulsion of foreign bodies, which have become impacted in the fauces or œsophagus. When with a distended stomach there is a feeling of nausea, and also in certain instances of sick headache, the emptying of the stomach may afford relief. (2) To expel the contents of the air-passages. Thus, an emetic often aids the expulsion of a foreign body lodged in the larynx. This class of drugs is especially useful in infants and young children, who cannot expectorate well, to clear the air-passages in bronchitis, laryngitis, diphtheria, etc. (3) To produce expectoration. The dose for this purpose is usually about one-tenth of the emetic dose, and is employed principally in the treatment of catarrhal conditions and coughs,

when the mucous secretion is deficient or thick and tenacious. The milder emetics should be chosen, as this action should be maintained without the production of actual vomiting. (4) To dislodge a gall-stone.

On account of the straining induced by the vomiting, emetics are as a rule contra-indicated in instances of aneurism, hernia, peritonitis, prolapse of the uterus or rectum, and where there is a tendency to hæmorrhage.

9. *Anti-emetics.*—The causes of vomiting being so numerous, agents which may serve as anti-emetics are many; but, as with emetics, only those substances will be considered which act either on the stomach or on the vomiting center.

(*a*) *Anti-emetics acting on the stomach.*—These have been already enumerated as having a sedative influence on the gastric nerves (*see* p. 619).

Some drugs should be included which occasionally appear to have a specific local action in arresting vomiting, as: cocaine, cerium oxalate, menthol and in minute doses, ipecac, tincture of iodine, arsenic trioxide, alcohol, phenol, chloroform, creosote, ether, silver nitrate, and the phenolsulphonates are sometimes useful.

(*b*) *Anti-emetics acting centrally—*

(1) Opium.
(2) Most bromides.
(3) Hydrated chloral.
(4) Amyl nitrite.
(5) Nitroglycerin.
(6) Diluted hydrocyanic acid.
(7) Alcohol.

It will be noticed that some drugs fall under both headings.

Therapeutics.—The really efficient method by which to treat vomiting is to remove the cause, but, this is not always possible. These drugs are, indeed, only palliative, and all are quite uncertain. Sometimes, however, one will be successful in controlling vomiting where a number of others have failed. Perhaps the most trustworthy anti-emetics are ice, diluted hydrocyanic acid, carbon dioxide, bismuth salts, morphine and menthol.

D. Drugs acting on the Intestines.—Owing to various circumstances, among which may be mentioned the lack of accurate knowledge regarding both intestinal physiology and pathology and the fact that many drugs are altered in composition by the time they reach this portion of the alimentary tract, it is as yet impossible to lcassify the drugs acting on the intestines upon a physiological basis.

We have, in fact, only three important divisions: purgatives, antiseptics and astringents.

One of the methods of experimentation which has been used to determine the mode of action of purgatives is as follows: Four ligatures are put around the intestine at equal distances apart, so that three pieces, each of the same length, are shut off from the rest of the intestine and from each other. The drug to be experimented upon is injected into the middle-piece, and the whole returned into the abdominal cavity. In a few hours the animal is killed, and the state of the interior of the middle piece is contrasted with that of the pieces on either side of it. Before these experiments there had been much discussion as to whether some purgatives did not act only by increasing the action of the muscular coat, and others only by stimulating the secretions. It was found that probably the majority act in both ways, some very slightly on the secretion and powerfully on the muscle, and others slightly on the muscle and powerfully on the secretion.

1. **Purgatives** are divided into the following classes:

(*a*) *Laxatives.*—These are substances which slightly increase the action of the bowels, chiefly by stimulating their muscular coat.

They are—

(1) **Honey.**
(2) **Manna.**
(3) **Castor oil.**
(4) **Olive and other oils used for food.**

These are well known domestic remedies, and habitually used by persons inclined to constipation. Ergot, physostigma, nux vomica, belladonna, hyoscyamus, and stramonium are also laxatives, but are not used except under medical direction. Ergot so often produces diarrhœa that its purgative action should be kept in mind. Physostigma is frequently employed for its effect by increasing peristalsis. Nux vomica is thought to increase the tone of the intestine, and is frequently prescribed in association with purgatives. In small doses belladonna increases peristaltic movements, for the reason that it paralyzes the inhibitory fibers of the splanchnics. In moderate doses, however, it completely arrests peristalsis, and it is largely given for this purpose, especially in combination with opium. Hyoscyamus, in small doses, is frequently combined with the stronger purgatives in order to counteract the irregular contractions they induce, and thus prevent griping.

(*b*) *Simple Purgatives.*—These are somewhat more powerful in their action than laxatives; promoting peristalsis and also increasing intestinal secretion. Some of the laxatives, as castor oil, when given in large doses, act as simple purgatives.

The simple purgatives are—

(1) **Aloes.**
(2) **Rhubarb.**
(3) **Frangula.**
(4) **Cascara sagrada.**
(5) **Senna.**
(6) **Phenolphthalein.**
(7) **Oxgall.**

Rhubarb and senna contain chrysaphanic acid, while all, excepting phenolphthalein and oxgall, owe their purgative properties to emodin, and are often called anthracene purgatives. These are constantly prescribed, and each has its special indications, which will be pointed out when their several actions are described.

(*c*) *Drastic Purgatives, often called Cathartics.*—These cause markedly increased secretion and peristaltic movements, and in large doses severe irritation of the intestine, characterized by excessive secretion of mucus, pronounced vascular dilatation—possibly hæmorrhage—and profuse, loose stools. This condition is attended with intense abdominal pain and tends to produce collapse. It is customary to prescribe hyoscyamus or belladonna with these drugs, calomel excepted, on account of the irregular peristalsis and severe griping pain which would otherwise be induced.

The drastic purgatives are as follows:

(1) **Calomel.**
(2) **Podophyllum.**
(3) **Jalap.**
(4) **Scammony.**
(5) **Gamboge.**
(6) **Colocynth.**
(7) **Elaterin.**
(8) **Croton oil.**

The most powerful are placed last. Some, as jalap, elaterin and scammony, are often called **hydragogue,** because of the large amount of secretion which they excite.

Therapeutics.—These drugs are very useful in severe constipation, and are also frequently given for the purpose of withdrawing fluid from the body in consequence of the watery evacuations they occasion. Thus, for instance, jalap is in constant use to fulfill this indication in Bright's disease.

(*d*) *Saline Purgatives.*—The action of these is obscure. They differ from the vegetable purgatives in not inducing intestinal irritation, unless when given in very large quantities. They are absorbed

from the intestine very slowly, probably because they fail to penetrate into the cells, just as the salts of the heavy metals fail to penetrate the red blood-corpuscles. There is a distinct affinity between the intestinal epithelium and sodium chloride, but only a much weaker one between it and the saline cathartics, which do not permeate it. It seems certain that these remedies very greatly increase the secretion of intestinal fluid, and hinder its reabsorption, so that a large amount of it accumulates in the intestine. Secretion goes on till the fluid in the intestine has become a 5 or 6 per cent. solution of the drug, so that if a very concentrated solution is given, much intestinal fluid is secreted, which tends to excite peristalsis mechanically, and, in addition, a salt stimulation results from the withdrawal of liquid and salts from the cells, as well as from the slight absorption of the salt itself. As a final result there are produced an increase in quantity and number of stools of a fluid consistency. It has been denied that catharsis results if the salts are injected into the blood, but in medical practice it has been repeatedly demonstrated that magnesium sulphate, administered hypodermatically, purges. It is possible that other salines may act similarly.

The saline purgatives are—

(1) **Potassium and sodium tartrate.**
(2) **Potassium bitartrate.**
(3) **Sodium sulphate.**
(4) **Sodium citrate.**
(5) **Sodium phosphate.**
(6) **Magnesium sulphate** and other salts.

Therapeutics.—These are very largely used as habitual purgatives, and such salts constitute the essential ingredients of the various mineral waters, such as Hunyadi János, Apenta, Pullna, Friedrichshall, Æsculap, Rubinat Condal, Villacabras, etc. The most efficient way of using them is to add some hot water to the required dose of the salt or of the mineral water, in a tumbler and slowly sip it in the morning.

Cholagogue purgatives, so-called, will be considered under Drugs Acting on the Liver (*see* p. 627.)

Enemata.—Any fluid preparation, injected into the rectum is called an enema. It is customary to give purgatives in this way when there is danger of their exciting nausea or when, in consequence of peritonitis or of obstruction, ulceration or other affection of the intestines, it is inadvisable to administer them by the mouth. Castor oil, olive oil, soap, aloes and magnesium sulphate are among the

substances most commonly employed for purgative enemata, enough of the vehicle selected for the injection being used to make an enema of at least 350 mils (¾ pt). Such enemata act mainly by distending the bowel and thus exciting peristalsis, although the soap or other agent employed no doubt has an irritating effect in addition. A teaspoonful (4 mils) of glycerin injected into the rectum, or the same amount given as a suppository, often promptly opens the bowels.

2. **Intestinal Antiseptics.**—These are believed to check fermentation and putrefaction in the intestines and are—

(1) **Betanaphthol.**
(2) **Bismuth betanaphthol.**
(3) **Bismuth subsalicylate.**
(4) **Phenyl salicylate.**
(5) **Chlorine.**
(6) **Creosote.**
(7) **Corrosive mercuric chloride.**
(8) **Oil of turpentine.**

Therapeutics.—Betanaphthol destroys micro-organisms *in situ*. Bismuth betanaphthol is nearly insoluble in water but may be partially dissolved by hydrochloric acid and does not cause symptoms of irritation. Bismuth subsalicylate has not the irritating properties of betanaphthol, but appears to be equally effective. Phenyl salicylate decomposes only in an alkaline solution, and this is useful for action in the small intestine. Chlorine water, no longer official, has been used for the disinfection of the intestines in typhoid fever. Creosote is valuable if administered in the form of enteric pills, which are soluble only in the intestinal fluids. Corrosive mercuric chloride is too poisonous for use, save in exceptional instances. Brilliant success has been achieved with oil of turpentine in the treatment of typhoid fever. The intelligent use of the foregoing drugs has greatly improved the success of the treatment of the various forms of enteritis, diarrhœa, colitis, dysentery and typhoid fever.

3. **Intestinal Astringents.**—These may be described under the following heads:

(*a*) *Astringents acting on the vessels of the intestine.*—These are the same as those acting on vessels generally. Those employed for their action on the intestine are—

(1) **Lead salts.**
(2) Dilute **solutions of silver salts.**
(3) **Alum.**
(4) Diluted **sulphuric acid.**

(*b*) *Astringents coagulating albuminous fluids and thus constricting the vessels:*—

(1) **Tannic acid**, and
(2) **Kino**,
(3) **Cinnamon**,
(4) **Gambir**, which contain it.
(5) **Lead salts**,
(6) **Silver salts**,
(7) **Zinc salts**,
(8) **Bismuth salts**,
(9) **Copper salts**, and especially
(10) **Ferric salts**.

(*c*) ***Astringents diminishing the amount of intestinal fluid secreted:***

(1) **Opium**. (2) **Lead salts**. (3) **Calcium salts**.
The precise mode of action of these is obscure.

(*d*) ***Astringents diminishing the contractions of the muscular coat of the intestines:***

(1) **Opium**.
(2) **Belladonna**.
(3) **Hyoscyamus**.
(4) **Stramonium**.
(5) **Lead salts**.
(6) **Calcium salts**.
(7) **Bismuth salts**.

Therapeutics.—The most important point in the treatment of diarrhœa is to remove the cause, if possible. Not uncommonly the cause is the presence of irritating matters in the intestine, and a mild purgative, such as castor oil or rhubarb, is indicated to remove them. In many instances a certain amount of enteritis appears to be present in diarrhœa, and remedies serving to constrict the dilated vessels and to diminish intestinal movements and secretion are called for. Hence, it is often advantageous to combine two or more astringents. Opium has long been recognized as an agent of very great value in diarrhœal diseases, and is a very frequent ingredient in prescriptions employed for them. In such troubles, however, it is essential that the diet should be very carefully regulated, and if the symptoms are at all severe, absolute rest and attention to keeping the patient warm are called for. If there is a persistent cause, as tuberculous ulceration, palliation of the symptoms is generally all that can be expected.

E. Drugs Acting on the Liver.—The liver has several distinct functions; viz.: To secrete bile, to form and store up glycogen; to form urea; to excrete substances absorbed from the intestine; and to destroy poisonous substances taken up from the intestine.

1. *Drugs Influencing the Secretion of Bile.*—Because an increased amount appears in the fæces it does not necessarily follow that more bile is secreted. Thus, if may be that the gall bladder and ducts have been thoroughly emptied, or that the bile which has been poured into the duodenum has been swept along quickly before re-absorption,

which is ordinarily rapid, has had time to take place. Drugs which increase the amount of bile actually secreted are called **direct cholagogues.** They are also sometimes spoken of as **hepatic stimulants,** but this is an unsatisfactory designation on account of the liver having so many different functions. Drugs which simply lead to a larger amount of bile being found in the fæces, without any additional secretion, are called **indirect cholagogues.**

DIRECT CHOLAGOGUES.—These have been studied in persons suffering from biliary fistula. A canula having been inserted into the bile-duct, in order to conduct the fluid outside the body, the amount of bile secreted before and after the administration of the drug under experiment is noted. A fasting state is essential because food itself causes a considerable increase in the biliary flow.

Direct cholagogues, the most powerful being placed first, are—

(1) **Sodium salicylate.**
(2) **Sodium benzoate.**
(3) **Podophyllum.**
(4) **Corrosive mercuric chloride.**
(5) **Sodium sulphate.**
(6) **Sodium phosphate.**
(7) **Aloes.**
(8) **Colocynth.**
(9) **Jalap.**
(10) **Scammony.**
(11) **Rhubarb.**
(12) **Ipecac.**
(13) **Diluted nitrohydrochloric acid.**
(14) **Colchicum.**

There are individual differences among direct cholagogues. Some increase the fluidity of the bile, while others have the opposite effect. Sodium salicylate and sodium benzoate markedly increase both the total quantity and the solids. Podophyllum, on the other hand, increases the solids without affecting the quantity, but its purgative action is so vigorous that it is usually placed among the drastic purgatives. In fact the salicylates and, to a lesser extent, the benzoates and diluted nitrohydrochloric acid are really the only drugs of distinct cholagogue action.

INDIRECT CHOLAGOGUES.—These appear to stimulate the lower part of the duodenum and the upper part of the jejunum, thus sweeping the bile on before there is time for it to be re-absorbed.

They are—(1) **Mercury, especially Calomel.** (2) **Most Cathartics.**

Therapeutics.—Cholagogues are used in instances of digestive derangement in which hepatic disorder seems to be the cause of the disturbance, and in order to secure the excretion of the bile, as well as the secretion of a proper amount, it is often advantageous to combine direct and indirect cholagogues. Bile being a stimulant to peristalsis,

all cholagogues naturally have a purgative action. In instances of indigestion, in which the liver is at fault, careful attention to the diet is a matter of importance, and active exercise, such as dancing, tennis, golf, horseback riding, rowing, etc., is of service in promoting the expulsion of bile from the gall-bladder and ducts.

ANTICHOLAGOGUES.—These decrease the quantity of the bile secreted, and are sometimes called **hepatic depressants.** Calomel, castor oil, gamboge, magnesium sulphate, opium and lead acetate have something of this effect, but it is not sufficiently pronounced to interfere with the therapeutic actions for which they are employed.

2. *Drugs Modifying the Glycogenic Function of the Liver.*—We here refer to those drugs which cause sugar to appear in the urine, and to those drugs which diminish the glycogenic function of the liver.

DRUGS CAUSING SUGAR TO APPEAR IN THE URINE.—Until recently it was assumed that all these drugs acted on the liver, probably by increasing the amount of sugar made from the store of glycogen in the liver; but we now have reasons for believing that sometimes the pancreas may be the organ at fault in diabetes, for its excision causes sugar to appear in the urine, and other symptoms of diabetes; also it has been suggested that perhaps some perversion of processes going on in the muscles may cause diabetes. Therefore it is rash to assume that all drugs causing sugar to appear in the urine (glycosuria) must act on the liver (*see* p. 563).

DEPRESSANTS OF THE GLYCOGENIC FUNCTION.—**Phosphorus, arsenic,** and **antimony,** diminish and may even arrest the formation of glycogen by the liver; they also cause fatty degeneration of the organ. In many instances of diabetes **opium, morphine** and **codeine,** and **uranium nitrate** have a marked effect in diminishing the quantity of sugar in the urine.

3. *Drugs Modifying the Formation of Urea by the Liver.*—The quantity of urea excreted by the urine is increased by phosphorus, arsenic, antimony, ammonium chloride, and iron. Phosphorus may also lead to the appearance in the urine of leucin and tyrosin. There is some evidence that this drug causes an increase of the urea through its action on the liver, for in phosphorus poisoning, that organ undergoes extreme fatty degeneration, and jaundice supervenes. Whether the other drugs act through the liver is uncertain, but antimony and arsenic, like phosphorus, are capable of producing general fatty degeneration Very large doses of all these substances are required

to increase the amount of urea in the urine, and they are not employed therapeutically for this purpose.

Opium, colchicum, alcohol and quinine are among the drugs stated to decrease the quantity of urea excreted.

F. Drugs Acting on the Pancreas.—Fats and fatty substances, mineral acids and many drugs which stimulate the production of gastric juice increase the amount of pancreatic secretion. Alkalies, because of their effect on gastric secretion, diminish it.

Drugs Acting on the Stomach

(*a*) Stomachics.

CALUMBA

For the Preparations of Calumba *see* p. 181.

Action of Calumba

Calumba is a typical simple **bitter.** It irritates the terminations of the gustatory nerves in the papillæ and mucous membrane of the tongue, increasing the appetite and reflexly stimulating the salivary and gastric secretions. The reflex action of bitters has been studied by Pavlow's method of anticipatory feeding in a dog in which œsophagotomy had been performed and a gastric fistula also established. The bitter substances, therefore, did not pass into the stomach, and the reflex effects of their presence in the mouth could be accurately judged. It was found that if a solution of a bitter was put into the mouth immediately before food was administered, a marked stimulant effect upon gastric secretion resulted; but if the bitter was used fifteen to thirty minutes before the meal it was quite inefficacious. It is concluded, therefore, that these substances have the power of rendering gustatory sensations more acute and of exercising a temporary stimulant effect upon gastric secretion. For this purpose they should be given as tinctures and in small doses.

Gastro-intestinal Tract.—The digestion is improved, as there is vascular dilatation, and the **secretion of gastric juice is increased** by this, as well as by the arrival in the stomach of an increased amount of alkaline saliva; while the gastric and intestinal movements also appear to be somewhat augmented. The secretions of the pancreas

and the bile are unaffected. Too large doses are apt to interfere with digestion and their long-continued use induces gastric catarrh and consequent indigestion. Like some other bitters, it is feebly anthelmintic.

Blood and Circulation.—The leucocytes of the blood are markedly augmented, which may possibly assist in the absorption of food, and the red corpuscles are also stated to be increased.

Therapeutics of Calumba

Calumba and other simple bitters are often of material service in instances of anæmia and weakness, and in convalescence from acute diseases. In general, they may be said to be most advantageous in debilitated conditions in which the stomach participates in a feebleness of all the various organs. Calumba is the mildest agent of its class, and may be used with safety in many instances when other bitters would be too irritating.

The use of bitters ought to be combined, whenever possible, with measures designed to relieve the cause of the indigestion. They should not be given in too concentrated form, nor employed for too long a time continuously. They are contra-indicated in acute and subacute inflammation of the stomach, or when the secretion of gastric juice is diminished as the result of organic disease. Neither should they be prescribed during the continuance of acute febrile diseases. Should the appetite remain good, although the digestion is impaired, it will usually indicate that the indigestion is intestinal, and remedies other than the bitters are called for.

Thread-worms may be treated by the rectal injection, the patient being in the knee-chest position, of 250 mils (1 pt.) of the infusion, which is extemporaneously made with calumba, 12, in cold water, 250; to avoid extracting the starch.

GENTIAN

For the Preparations of Gentian *see* p. 181.

Action and Therapeutics of Gentian

Gentian has the same action as calumba and other simple bitters. It is given in the same conditions as the other drugs of its class,

and, on account of its more **agreeable flavor**, it is perhaps more widely used than any of the rest. The compound tincture is esteemed an excellent vehicle for the administration of cod liver oil, the digestion and assimilation of which it serves to promote.

QUASSIA

For the Preparations of Quassia *see* p. 182.

Action and Therapeutics of Quassia

Quassia is an aromatic, bitter stomachic, which has the same action as gentian.

As it contains no tannic acid, it is often prescribed with iron. On account of its **intense bitterness** it is objectionable to some patients. A goblet made of quassia wood may be used, by allowing water to stand in it for a number of hours, for making an extemporaneous infusion of the drug. Like calumba, 250 mils (½ pt.) of the extemporaneous infusion, 1 to 100 of cold water to avoid extraction of too much of the bitter principle, injected into the rectum, with the patient in the knee-chest position, may be used with advantage against thread-worms.

SERPENTARIA

For the Preparations of Serpentaria *see* p. 183.

Action and Therapeutics of Serpentaria

Serpentaria is a bitter which in large doses causes nausea, vomiting, colic, flatulence and rectal tenesmus, with frequent, but not watery stools.

It may be employed as a **bitter stomachic**, and is of considerable utility as an ingredient of the compound tincture of cinchona. It is not administered alone.

TARAXACUM

For the Preparations of Taraxacum *see* p. 183.

Action and Therapeutics of Taraxacum

Taraxacum is a simple bitter, promoting the appetite. It is a mild laxative and as such may, by reflex stimulation, have some

effect in tending to evacuate the gall bladder. The vulgar name by which dandelion is known both in England and France suggests that it may be diuretic.

It is still occasionally prescribed, in the form of extract or fluid-extract, as a **laxative** in catarrhal jaundice, in combination with ammonium chloride. Its utility as a diuretic seems to be problematical.

CLOVE

For the Preparations of Clove *see* p. 197.

Action of Clove

External.—Oil of clove has antiseptic properties. Rubbed into the skin, or applied to mucous membranes, it is irritant, producing hyperæmia and the burning sensation to which it at first gives rise is followed by anæsthesia of the part.

Internal. *Mouth.*—In the mouth the nerves of taste and smell are stimulated and the salivary glands excited to increased secretion.

Stomach.—Oil of clove is **carminative**, and its gastric effects constitute the important part of its action. It has the characteristic action of the volatile oils, inducing dilatation of the blood-vessels, stimulating the secretion of the gastric glands, and accelerating the movements of the stomach, in consequence of which there is more or less eructation of gas. In the stomach a grateful sensation of warmth is experienced, and it increases appetite and digestion. By the stimulation of the gastric nerves, the rate and force of the heart are consequently moderately increased.

Intestine.—Similar effects are produced in the intestine, though it is not positively known whether the peristaltic movements of the latter are increased by the volatile oils. At all events, flatulence and distention are relieved, an effect which may be due in part at least to the **antiseptic** action. It is well known that the colic caused by some of the powerful purgatives is diminished by the administration with them of oil of clove and other volatile oils. It has been shown that the intestine, like the stomach, absorbs more rapidly in the presence of small quantities of these oils. Oil of clove, like others of its class, is capable when given in sufficient quantity of exciting gastro-enteritis.

Excretion.—Oil of clove is absorbed from the intestine, and in the course of its excretion exerts more or less irritant action on the kidneys and respiratory passages, the secretions of which it tends to disinfect.

Eugenol has the same action as the oil of clove, of which it is one of the chief constituents.

Therapeutics of Clove

External.—On account of its local anæsthetic action it is sometimes employed as an external application for neuralgias. It is of service, in an ointment made with hydrous wool-fat, in some instances of eczema, and in lupus vulgaris its repeated application may cause retrocession of the nodules. As a parasiticide it has been used for pediculosis. It is one of the remedies most commonly resorted to for the relief of pain of carious teeth, and is an important constituent of many "toothache drops." It is sometimes employed to give a pleasant odor to liniments.

Internal.—The oil may be given as a stomachic or as a **carminative** for the relief of gastric or intestinal pain, and is sometimes combined with preparations of scammony, of castor oil, and of colocynth, to prevent griping. In **gastric fermentation** a combination of the oils of clove, cinnamon and peppermint, with creosote, administered three times a day in a soft capsule containing olive oil, has proved quite efficient.

OIL OF PIMENTA

For the Preparations of Oil of Pimenta *see* p. 198.

Action and Therapeutics of Oil of Pimenta

The therapeutics of oil of pimenta, as well as its action, since it contains eugenol, are practically the same as those of clove.

MYRISTICA

For the Preparations of Myristica *see* p. 199.

Action and Therapeutics of Myristica

Oil of myristica has the same action as that of other aromatic oils, although it is more toxic than most volatile oils. In addition to its

aromatic and carminative qualities, it is possessed of considerable narcotic power.

For mild instances of ringworm a liniment composed of one part of the oil to three of olive oil may be employed as an elegant **antiparasiticide.** Its volatile oil renders it an agreeable stomachic, and powdered or grated myristica is given as a **carminative** and anodyne for the relief of nausea or colic and, combined with other remedies, of diarrhœa. The narcotic properties of the drug make it of service at times in the treatment of delirium tremens.

CINNAMON

For the Preparations of Cinnamon *see* p. 200.

Action and Therapeutics of Cinnamon

Oil of cassia, which is distilled from cinnamon, has the same action as other aromatic oils. The powder, on account of its tannic acid, has considerable astringent property.

Finely powdered cinnamon is sometimes of service in arresting nausea and vomiting, Cinnamon is much used as an ingredient of carminative and astringent powders and mixtures, and is also combined with purgatives to prevent griping. On account of its tannic acid it is incompatible with iron preparations. For counter-irritation, especially in children, a **spice plaster** made by placing aromatic powder between two layers of flannel and moistening it with hot alcohol, is sometimes employed. Cinnamic aldehyde, not official (*see* p. 201) is used for the same purposes as the volatile oil of which it constitutes about 80 per cent.

LAVENDER

For the Preparations of Lavender *see* p. 204.

Action and Therapeutics of Lavender

The oil has the same action as the other aromatic volatile oils.

Its principal external use is as an agreeable stimulating ingredient of liniments and the compound tincture is largely employed to color lotions. Being a very **palatable carminative,** oil of lavender is in

frequent use in the treatment of nausea, flatulence, gastralgia, etc., and as an adjuvant or corrigent of other medicines. In hysterical and other nervous conditions it is a pleasant antispasmodic. As a tranquilizing remedy in various disturbed states of the system it is not infrequently combined with the spirit of ether (Hoffman's drops) which it renders less disagreeable for administration.

PEPPERMINT

For the Preparations of Peppermint *see* p. 205.

Action of Peppermint

Oil of peppermint has the action of volatile oils in general, and like others, especially those containing a considerable amount of terpene (menthene), it is actively antiseptic.

Menthol is **antiseptic** and **locally anæsthetic,** producing a sensation of coldness wherever it is applied. The blood-vessels of the part are, however, dilated, and instead of there being a fall of temperature, the skin temperature is higher there than elsewhere. The feeling of coldness is associated with more or less prickling, and later there follows some heat and burning. Like camphor, menthol stimulates the central nervous system, and its general effects are practically identical, except that the convulsions to which it gives rise are much less severe. It acts chiefly on the terminations of the nerves of common sensation or of pain. It is excreted in combination with glycuronic acid.

Therapeutics of Peppermint

External.—The oil, from the menthol contained in it, is of value in many instances of neuralgia.

Menthol, externally applied, will often relieve **neuralgic pains,** provided they are of superficial and peripheral origin. The solid menthol, in the form of a cone, is sometimes employed for this purpose, and sometimes it is used in alcoholic solution. Rubbed up with an equal part of camphor, hydrated chloral, or phenol, and placed in the cavity, it promptly cures the aching of a carious tooth. An excellent combination for inflamed joints, whether the inflammation is rheumatic or gonorrhœal, is a mixture of menthol, thymol and hydrated chloral rubbed up together until liquefied, and painted over

the inflamed part. These combinations are also applicable in local neuralgias. Menthol is very useful for allaying **itching**, and is employed in solutions, to which other drugs may be added, if called for, in such affections as pruritus ani, urticaria, eczema and herpes zoster. In laryngeal tuberculosis great relief is afforded by a 20 per cent. solution in olive oil, introduced into the larynx as a spray. Menthol is now used to a considerable extent topically in diseases of the ear and nose. In the nasal form of hay fever a mixture of menthol and ammonium carbonate has been found to make a very efficient smelling-salt.

Internal.—Peppermint is very largely employed as an efficient **carminative**, often in association with sodium bicarbonate, and also, as a flavoring agent. For promoting diuresis the spirit, in hot water, is more effective, and it is especially well suited to children.

Menthol has been used in minute doses to relieve nausea and vomiting. In full doses, in capsules with olive oil, six or eight being taken daily, it has been given as an intestinal antiseptic. In spasmodic cough, asthma and hiccough, it is sometimes of service.

SPEARMINT

For the Preparations of Spearmint *see* p. 206.

Action and Therapeutics of Spearmint

It has the same action as peppermint, but less pronounced.

The therapeutic applications of spearmint are the same as those of peppermint, but its oil is not so agreeable as, and is in less general use than, oil of peppermint.

ANISE

For the Preparations of Anise *see* p. 207.

Action and Therapeutics of Anise

The action of oil of anise is the same as that of aromatic oils generally. Although anise imparts a peculiar taste to the milk of nursing women, it apparently does not augment the secretion.

Anise is the most **pleasant carminative** for infants and young children, and has some efficacy as an expectorant, hence it is employed as an agreeable component of cough mixtures. It is contained in the camphorated tincture of opium (paregoric).

CORIANDER

For the Preparations of Coriander *see* p. 208.

Action and Therapeutics of Coriander

Oil of coriander has the same action as that of other aromatic volatile oils.

Coriander is used for **flavoring purposes**, for disguising the taste of senna and rhubarb, and for preventing the griping of these and other purgatives.

FENNEL

For the Preparations of Fennel *see* p. 209.

Action and Therapeutics of Fennel

Oil of fennel has the same action as that of anise and other similar oils. It has been supposed to have the effect of increasing the secretion of milk, urine, perspiration and bronchial mucus.

As one of the most grateful of the various aromatics, fennel is employed very largely as a **carminative**, and as a corrective against the griping effects of purgatives. It is sometimes used as an adjuvant, in the treatment of amenorrhœa dependent on uterine congestion and for re-establishing the mammary secretion when suppressed.

CARAWAY

For the Preparations of Caraway *see* p. 210.

Action and Therapeutics of Caraway

The action of oil of caraway is the same as that of similar oils.

Caraway is used chiefly as a **flavoring** agent and a carminative, especially in mixtures designed for infants.

MATRICARIA

For the Preparations of Matricaria *see* p. 210.

Action and Therapeutics of Matricaria

Matricaria has the general action of the volatile oils. It is frequently used as a **stomachic** and carminative, and administered in a

large amount of hot water, it is employed in domestic medicine as a diaphoretic.

ROSE

For the Preparations of Rose *see* p. 211.

Action and Therapeutics of Rose

Preparations of rose are somewhat astringent.

The water is an **agreeable excipient** for collyria, lotions and urethral injections. The ointment of rose water is a favorite soothing application for the skin.

ORANGE

For the Preparations of Orange *see* p. 184.

Action and Therapeutics of Orange

Orange is slightly bitter and aromatic. Its oil, obtained from the peel, has the action of other volatile oils; in large amounts it is a gastro-intestinal irritant and may give rise to convulsions. Persons much exposed to its vapor are liable to skin eruptions and various nervous disorders.

The preparations of orange are used extensively for **flavoring** purposes. The juice, not official, may be employed for the prevention of scurvy, especially in children. The aromatic elixir and the elixir of glycyrrhiza, which contains it, are excellent flavoring agents and vehicles for liquid medicines.

LEMON

For the Preparations of Lemon *see* p. 186.

Action of Lemon

This is the same as of orange. Lemon juice, which contains a considerable amount of free citric acid, naturally acts the same (*see* p. 470).

Therapeutics of Lemon

The preparations of lemon, like those of orange, are employed as flavoring agents. The oil may be applied externally as an efficient rubefacient.

Lemon juice, in the form of lemonade and various effervescing mixtures, relieves thirst, and makes an otherwise refreshing beverage. Hot lemonade, to which whiskey is often added, is useful as a diaphoretic in commencing colds. Lemon juice is also largely employed for flavoring flaxseed tea and the mildly nutritive drinks given in fevers. Its most important medicinal use is in the prophylaxis and treatment of **scurvy**, in which it may be considered specific. The beneficial effect appears to be due, not to the citric acid, but to some unknown property of the juice. It may be applied to the integument to relieve pruritus and to remove freckles. For sunburn an excellent lotion is made of equal parts of lemon juice and glycerin, with the addition of some bismuth subnitrate.

PEPPER

For the Preparations of Pepper *see* p. 199.

Action and Therapeutics of Pepper

Pepper by reason of the volatile oil contained in it has much the same action as clove. In the course of its excretion it acts as a disinfectant and stimulant to the genito-urinary tract.

It is occasionally employed for **counter-irritation**, as a substitute for mustard, and, in lotions and gargles, for relaxed condition of the throat. Its chief medical application is to correct flatulence. In malarial fevers the oleoresin has proved of service as an adjuvant to other remedies.

PYRETHRUM

For the Preparations of Pyrethrum *see* p. 197.

Action and Therapeutics of Pyrethrum

Pyrethrum is an irritant **sialogogue**. When chewed it has a prickly, pungent effect upon the mouth, and excites a free secretion of saliva and buccal mucus. It is a rubefacient and when inhaled into the nostrils causes sneezing. Internally it has the characteristic action of the volatile oils, and when taken in considerable quantities may cause gastro-enteritis, with bloody stools, and more or less stupor.

It is chewed as a **masticatory** in paralysis of the tongue, and when in other conditions an increased flow of saliva is desired. In painful affections of the tongue or teeth it may also be held in the mouth, as the burning sensation to which it at first gives rise is followed by one of numbness; the stimulation of the nerves of the parts which it causes being succeeded by a blunted sensibility. Properly diluted, it makes an efficient lotion for scorbutic and other forms of sore mouth and gargle for relaxed uvula. Pyrethrum is sometimes used as an ingredient of tooth-powders. Its sialogogue action has been found of service in the removal of iodine from the system in instances of chronic poisoning by that drug.

CAPSICUM

For the Preparations of Capsicum *see* p. 201.

Action of Capsicum

Although it contains a volatile alkaloid but no volatile oil, the action of capsicum is like that of the volatile oils generally. It is a powerful **local irritant,** its oleoresin when applied to the skin producing in a short time intense pain and redness, and eventually destroying the cuticle. In the stomach, in small doses, it occasions a feeling of warmth, excites hyperæmia, and stimulates the muscular wall and the secretions, while large doses give rise to gastro-enteritis, which after a time is accompanied by strangury and other evidences of irritation of the genito-urinary tract. Aphrodisiac effects have sometimes been noted. It is chiefly eliminated by the kidneys, and moderate amounts increase the flow of urine. It is a powerful stimulant to the heart, and thus increases the strength and frequency of the pulse.

Therapeutics of Capsicum

External.—The tincture of capsicum has been used to stimulate the scalp in the various forms of alopecia. When diluted it makes a serviceable gargle in scarlet fever and for throat affections; in tonsillitis, with an equal quantity of glycerin, it may be topically applied. Mixed with an equal quantity of mucilage of acacia, it has been recommended in chilblains, when the surface is unbroken, discolored bruises, chronic rheumatic pains, etc. The preparation is brushed two or three times upon the affected surface. Capsicum

plaster is quite extensively used as a **rubefacient** and **counter-irritant.**

Internal.—It is an excellent remedy for flatulent colic and for atony of the stomach due to general debility, errors in diet, and subacute and chronic alcoholism. In acute alcoholism it should be given with caution, as there is likely to be present more or less gastric irritation, which may be aggravated by the drug. During convalescence, it may be given with advantage, as it serves to increase the appetite and digestive power, and by its stimulating effect it often satisfies, at least to some degree, the craving for liquor. In **delirium tremens** powdered capsicum is often valuable in quieting restlessness and inducing sleep. It should here be given in a dose of about 2 gm. (30 gr.), which may be administered in an animal broth or made into a bolus with honey. Tincture of capsicum has been resorted to in the treatment of the opium, as well as the alcohol, habit. Good results may often be obtained from it in functional impotence; the oleoresin is the best preparation for use in this affection.

GINGER

For the Preparations of Ginger *see* p. 202.

Action and Therapeutics of Ginger

Ginger has the same action as that of other substances containing aromatic volatile oils.

It is much used as a carminative, and flavoring agent. It is frequently employed as a **sudorific,** with large quantity of hot water and stimulant in the pain due to acute suppression of the menses. It may be given with salines to disguise their taste, and the oleoresin is a useful addition to purgative pills to prevent griping.

CARDAMOM SEED

For the Preparations of Cardamom Seed *see* p. 204.

Seed Action and Therapeutics of Cardamom Seed

Cardamom is carminative, acting by reason of its volatile oil, like clove or pepper.

As the compound tincture has a bright red color, due to its cochineal, and an agreeable **aromatic** taste, it is frequently employed as a coloring and flavoring agent. It is a customary addition to mixtures given for the relief of flatulent colic, and makes one of the best flavoring additions to saline mixtures, and when combined with purgatives is very efficient in correcting griping.

(*b*) **Digestants.**

PEPSIN

For the Preparations of Pepsin *see* p. 246.

Action of Pepsin

The only action of pepsin, which is a normal constituent of the gastric juice, appears to be on the alimentary system, where in the presence of normal amounts of hydrochloric acid it **digests** the **proteid elements** of the food, converting them into soluble proteids, albumoses and finally into peptones. In alkaline solution it is not only inert, but is rapidly decomposed. It is destroyed by 0.01 per cent. solution of sodium hydroxide and ceases to act when a solution of hydrochloric acid reaches 0.3 per cent.

Therapeutics of Pepsin

Pepsin is usually prescribed on the hypothesis that in certain conditons the stomach does not secrete a sufficient quantity of it. It has been questioned, however, whether this is true in even a small proportion of the patients to whom this ferment is given, since the gastric juice is found to be almost always capable of digesting proteid if it is acid in reaction. In some forms of dyspepsia, while the acid secretion is deficient, pepsin is generally present in quantity, therefore, hydrochloric acid should be administered, not pepsin. Pepsin would seem to be indicated only in those instances in which the gastric contents acidulated with hydrochloric acid fail to perform their digestive work. In the rather rare instances of **achylia gastrica** with atrophy of the gastric mucous membrane, pepsin with or without hydrochloric acid may make up the deficiency in the secretion of the digestive ferments. Pepsin may be used as an aid to stomach digestion in those in whom from old age, continued illness, or other cause, the secretion of gastric juice is inadequate. It has been found

to be more certain in its effects in the impaired digestion of infants than of adults, probably because in the former it is administered in proportionately much larger doses. When it is prescribed together with alkaline carbonates, any effects produced are due entirely to the latter, the pepsin being decomposed in the presence of alkalies. It is naturally of no service in promoting the digestion of fatty or carbohydrate foods. It should be administered, in a powder, pill or tablet, immediately after meals, and followed in about half an hour with a suitable dose of hydrochloric acid. One of the applications of pepsin is the **predigestion** by it **of albuminous food** (meat or eggs) which may then be given either by the mouth or the rectum, and as morbid processes which interfere with digestion may be going on in the stomach, this method is not infrequently preferable to using the ferment in the ordinary way. It is not suitable for the predigestion of milk because it acts best in an acid medium and also coagulates the milk. The rectum, as is well known, has only very feeble digestive powers, and consequently nutrient enemata or suppositories should always be predigested. In the use of predigested foods, either by the mouth or rectum, much discretion should be employed, and except in absolute necessity the method should not be maintained for a very long period continuously, as there is some danger that the digestive functions of the stomach, from lack of use, may become incapable of action.

PANCREATIN

For the Preparations of Pancreatin *see* p. 246.

Action of Pancreatin

Pancreatin, in the presence of alkalies, has the power of digesting **albuminoids** and all proteid substances, which are changed to peptones, of converting **starch** into sugar, and of emulsionizing **fats.** It coagulates and the peptonizes milk, and will also peptonize gruel and many other articles of diet. It acts best in an alkaline medium but is incapable of acting in a temperature above 60°C. (140°F.).

Therapeutics of Pancreatin

It is used as an artificial agent to assist the digestion of invalids and of old persons, or those prostrated by fever or exhaustion. In **achylia gastrica,** pancreatin and sodium bicarbonate may produce gastric digestion and this may be preferable to the use of pepsin and hydro-

chloric acid as the latter may act upon the pylorus. In mild, chronic **pancreatic disease** it has produced excellent results. In conditions of stunted growth with digestive disturbances, which are very infrequently met with, the administration of pancreatin has been sometimes successful, possibly, in antagonizing hyperthyroidism. Also by means of it food may be partially or wholly digested previous to administration. It should be used in combination with an alkali, as sodium bicarbonate, in the proportion of 1 to 4, which is also the proper proportion of water to milk. The process should never be carried out at a temperature above 65.5°C. (115°F.) and for not more than fifteen minutes, if intended for oral administration, otherwise a bitter taste will be developed. Nutritive enemata should be thoroughly pancreatized, for one-half to one hour. The mixture is then brought to the boiling point to destroy the enzyme and placed on ice and kept there until required. As a rule, pancreatin is found to be of more service for purposes of predigestion than pepsin; but pepsin and pancreatin in solution should never be combined. If pancreatin be administered two to four hours after meals it will **assist intestinal digestion**, and it is especially indicated in those conditions in which starch and fat are imperfectly digested. It should be preceded by full doses of sodium bicarbonate, or other alkali, to insure an alkaline reaction of the contents of the stomach. It is sometimes of service in the vomiting of pregnancy or of hysteria. In **diphtheria** a spray of trypsin, not official, the proteolytic ferment of pancreatin or pancreatin in solution, has been used with considerable success for the purpose of dissolving the false membrane and promoting its expulsion. Trypsin probably has but little effect on cancerous growths beyond the improvement in the general conditions. It does not succeed in the treatment of diabetes mellitus even if it be of pancreatic origin, although it may benefit patients suffering from chronic pancreatitis by enabling them to digest and absorb more proteids and fat. Pancreatin has also been employed in the bladder to dissolve blood-clots resulting from hæmorrhage.

DIASTASE

For the Preparation of Diastase *see* p. 233.

Action and Therapeutics of Diastase

Diastase digests starch in the mouth and in the stomach until the acidity of the gastric juice exceeds 0.1 per cent.

It has been employed for practically the same conditions as has pancreatin. It is certainly useful in a considerable number of patients who suffer from what has been termed amylaceous dyspepsia.

(*c*) **Carminatives.**

Many drugs already considered among the stomachics, especially the aromatic volatile oils, and substances containing them (*see* p. 630 *et. seq.*), are also carminatives.

VALERIAN

For the Preparations of Valerian *see* p. 190.

Action of Valerian

Valerian acts by virtue of its volatile oil, which has the same properties as other volatile oils. Valerian is therefore an **irritant** when applied externally, causing redness, itching and warmth by reason of the local dilatation of vessels which it induces. Internally it stimulates the mouth, leading to a reflex secretion of saliva, and the gastro-intestinal tract. It causes, in the stomach, a sense of warmth with reflex stimulation of the heart and nervous system. The slight irritation produces hyperæmia of the mucous membrane, with some increase of secretion, and the movements of the stomach are accelerated. Similar effects are observed in the intestine. While nervous effects are produced reflexly by the local action, sufficient doses affect the central nervous system independently of such local action in the way of stimulating the centers of psychic control and thus it allays so-called nervousness. Excretion takes place principally by the lungs and kidneys, and in the course of this action some irritation and increased secretion may be induced in these organs. Under large doses by the mouth, nausea, hiccough, eructations of the drug, vomiting and diarrhœa may be caused.

Therapeutics of Valerian

Valerian, in various forms, is much used as a carminative for the relief of flatulence, especially in hysterical conditions. Any feeling of fullness after meals is removed, and this is often accompanied by the eructation of quantities of gas. Preparations of valerian are likewise serviceable as reflex stimulants in syncope, palpitation,

when the reflex effect of the volatile oil upon the stomach is desired. Their chief therapeutic use, however, is in the treatment of **nervousness and hysterical disorders** generally, in which ammonium valerate is preferred by many. In neuralgic conditions the best preparation is zinc valerate, which has been employed with some success in nervous affections such as **chorea** and epilepsy. In both forms of diabetes the ammonium or zinc salt has been used with temporary advantage. It serves to diminish the amount of urine, and in the saccharine variety to lessen the excretion of sugar. It has no curative effect, however, for so soon as the remedy is discontinued all benefit from it ceases.

ASAFETIDA

For the Preparations of Asafetida *see* p. 191.

Action of Asafetida

Owing to its containing allyl sulphide, asafetida is extremely unpleasant to the taste. Its action is due entirely to its volatile oil, the effects of which are those of the volatile oils in general. On the intestine it has a specially marked **stimulant** action, producing an efficient carminative effect. It often has a powerful stimulant and anti-spasmodic effect upon the nervous system, and there is reason to believe that in hysterical subjects this is in part at least due to the mental influence resulting from the odor and taste of the drug. In some women an emmenagogue effect has been noticed from it. It is excreted by the lungs, skin and kidneys, and is found to act like other volatile oils in increasing and disinfecting the secretions.

Therapeutics of Asafetida

Were it not for the extremely disagreeable eructations to which it gives rise, asafetida might prove very useful in atonic dyspepsia accompanied by torpor of the bowel. Asafetida is especially serviceable in the flatulence of neurotic subjects, expelling the flatus, promoting intestinal secretion and digestion, and relaxing the bowels; and it is commonly very well borne by this class of individuals. Partly on account of its reflex stimulating effect, and partly on account of the moral effect of its offensive odor and taste, this remedy is not infrequently employed to control **hysterical**, and other **emotional**

disturbances, which it probably does by stimulating the higher cerebral centers and increasing the moral control of the emotions. It is employed in subacute bronchitis and bronchorrhœa, especially in old people, the cough succeeding the paroxysmal stage of pertussis, which is often maintained by habit, and the sympathetic cough of mothers whose children are suffering from whooping-cough; all of which conditions are found to be benefited by it. One method of curing malingering is to make the patient take, three times a day, an effervescing draught containing a few drops of the tincture of asafetida and valerian; the effervescence causing the unpleasant taste of the medicines to recur in the mouth for some time after they have been swallowed.

SUMBUL

For the Preparations of Sumbul *see* p. 192.

Action and Therapeutics of Sumbul

Little is known positively of the effects of sumbul on the system, but its action appears to resemble that of the volatile oils in general, and it is usually classed with the substances which are malodorous such as asafetida and valerian. It is carminative and is particularly an **antispasmodic.** It stimulates appetite, improves digestion, and allays irregular nerve action. It is said to directly influence the cerebro-spinal nerve centers and thus control spasm and restlessness dependent upon disturbances of their circulation.

Sumbul may be given for its carminative effects in flatulence. It is beneficial in excitable conditions of the nervous system, and among the affections in which it has been recommended are neuralgias occurring in hysterical subjects, **hysteria in general,** alcoholic insomnia, chorea, spasmodic conditions of the respiratory and genito-urinary tracts, nervous dyspepsia, neurasthenia, and the mental and emotional unrest of nervous females.

MYRRH

For the Preparations of Myrrh *see* p. 193.

Action of Myrrh

Its internal, as well as its external, effects are due to its volatile oil. In moderate doses it is **carminative,** stimulant and tonic, and in

large doses a **gastro-intestinal irritant,** exciting vomiting and purging. It is excreted by mucous membranes, especially the bronchial and the genito-urinary, and it is believed to increase the number of leucocytes in the blood. It is reputed to be a stimulant to the ovarian and uterine functions.

Therapeutics of Myrrh

External.—Diffused in water (1 to 16), with the addition of a little phenol or thymol, the tincture is a good mouth-wash for mercurial salivation or for wounds after operations upon the mouth, and may also be used as a gargle in pharyngitis, etc. As a mouth-wash it is more commonly associated with borax, and it has long been employed as an ingredient of dentifrices.

Internal.—Myrrh is frequently prescribed with purgatives on account of its carminative and stomachic properties, and, in combination with other remedies, is more or less employed in gastralgia. It is considered especially useful when this is associated with flatulence, mucous evacuations, constipation, and in the presence of nervous disorders of a **hysterical** or **hypochondriacal** character. Here it may profitably be combined with vegetable bitters and iron. It has been doubted whether myrrh really has any effect on the menstrual function, its apparent value in amenorrhœa being due, it is alleged, to the iron, aloes, or other drugs usually combined with it.

(*d*) **Gastric Sedatives.**

BISMUTH

For the Preparations of Bismuth Salts *see* p. 85.

Action of Bismuth Salts

External.—Bismuth salts have no action on the unbroken skin. On abraded surfaces they are **antiseptic** and **mildly astringent,** upon which when dusted, they form a protecting coat. Used in this way their value, as is with iodoform, probably depends not so much on their germicidal action as on their absorption of the fluids of the part, which renders the surface less favorable for the growth of bacteria.

Internal.—In the usual medicinal doses, the insoluble salts, although given for a long period, produce very few appreciable

symptoms. Any action which they may have in increasing peristalsis and the secretion of mucus in the stomach is probably simply that which would be caused by the presence of any heavy powder. In the intestine they are believed to have some effect in augmenting the leucocytes of the blood, and they are apt to induce more or less constipation. The stools are blackened, a result which is generally supposed to be due to the formation in the large intestine of bismuth sulphide, but which is attributed by some to the reduction of bismuth in the bowel. Occasionally a purplish line makes its appearance on the gums. So long as bismuth was employed only internally, no serious effects were produced by its insoluble salts, as it is now known that certain instances of poisoning formerly ascribed to them were in reality due to the arsenic, lead or antimony with which they were contaminated. Since their use has been extended to the treatment of wounds and abraded surfaces, however, several instances of dangerous intoxication have been observed, especially from the subnitrate, although the patients have generally recovered when the dressing was removed. Among the symptoms which have been noted may be mentioned black spots, or even gangrene, in the mouth and fauces, swelling of the gums, tongue and throat, increased flow of saliva, dysphagia, nausea, vomiting, diarrhœa and albuminuria. As much less bismuth is used for external applications than is often given by the mouth, it would appear either that the drug is more readily absorbed from raw surfaces than from mucous membranes or else whatever is absorbed from the alimentary canal is prevented by the liver from reaching the general circulation. Bismuth is excreted throughout the alimentary canal, but particularly in the large intestine, and also by the urine and possibly by the milk; and is stored in considerable amount in the liver. Bismuth salts act as **antiseptics**, and it is believed that the benefit derived from them is also due to some extent to their ridding the intestinal canal of hydrogen sulphide, in consequence of the avidity of bismuth for this irritant and odorous compound.

Therapeutics of Bismuth Salts

External.—Bismuth salts are useful as dusting powders for ulcers and excoriated surfaces and as a dressing for wounds, when not too large. For such purposes the subgallate is preferable. Bismuth beta-

naphthol and subcarbonate are also employed to some extent. In acne, vesicular eczema, intertrigo and the erythema of infants one of these salts may be lightly dusted over the surface. An ointment composed of bismuth subnitrate, boric acid, hydrous wool fat and olive oil has been found especially suited to the treatment of burns in children. The bismuth betanaphthol may be employed in the form of suppositories for ulcers of the rectum.

Internal.—Bismuth salts are used internally chiefly for their local action upon the alimentary tract, as they form a protective coating over the irritated or inflamed surfaces and keep them from coming in contact, and also exert an **astringent** and **antiseptic** influence. The soluble salt, bismuth and ammonium citrate, to be of use, must have bismuth precipitated from it in the alimentary tract. When absorbed it is likely to act as irritant and for this reason is objectionable. Of the insoluble ones, those most frequently prescribed are betanaphthol, the subnitrate, and subcarbonate, which are safer and also are more efficient than the soluble salt. The insoluble compounds are best given suspended in mucilage, which should be made with tragacanth, for when acacia is used a compact mass is formed. However they may effect these results, bismuth preparations are very efficacious in relieving **gastric pain,** whether due to organic disease, such as scirrhus, or to less serious causes, and also not infrequently in checking vomiting of whatever origin. They are of great service in both acute and chronic gastritis, and also in gastric ulcer, where they not only alleviate the pain but contribute to the cure of the condition. Sodium bicarbonate often enhances their effects as gastric sedatives, but it should not be prescribed in a mixture with the subcarbonate, as the formation of carbon dioxide is likely to result. Bismuth salts, especially the subgallate, and the betanaphthol are useful likewise in the treatment of **diarrhœa** of various kinds due to irritation and inflammation of the intestinal tract. They are generally most efficient when given in large doses, and this is especially true in chronic diarrhœa and in that of tuberculosis; the subsalicylate is very useful for it probably passes through the stomach unchanged, to be broken up in the small intestine, where it acts as an unirritating antiseptic. It has been proved to be a valuable remedy in the treatment of diarrhœa of typhoid fever, and catarrhs of the alimentary tract.

In Roentgen-ray diagnosis large quantities of bismuth are often

introduced into the alimentary tract either through the mouth or by way of the rectum. The subnitrate, on account of its likelihood to produce poisoning, should not be used. The subcarbonate in 60 gm. (2 oz.) doses suspended in thick soup is commonly employed.

TOXICOLOGY

When applied in large quantity to an exterior wounded surface or injected into chronic sinuses or tuberculous cavities sufficient bismuth may be absorbed to produce poisoning. This may also occur if glycerin is used to form a so-called emulsion for injection.

Symptoms.—These are, acute stomatitis with a peculiar blackish discoloration of the mucous membrane, generally upon the borders of the teeth and extending over the whole mouth, salivation, nausea and vomiting, intestinal catarrh, especially of the colon with ulceration of the mucous membrane, pain and diarrhœa. Even desquamative nephritis may be set up.

Treatment.—Use demulcents. If it occurs during the bismuth treatment of sinuses it is sufficient to evacuate the bismuth by syringing with warm olive oil and irrigate them daily with the same substance, until the symptoms subside.

CERIUM OXALATE

For the Preparations of Cerium Oxalate *see* p. 83.

Action and Therapeutics of Cerium Oxalate

Very little is known of the effects of cerium oxalate, but when injected into the circulation it is said to produce gastro-intestinal irritation, with vomiting and diarrhœa and hyperemia and ecchymoses of the mucous membranes, and also congestion or inflammation of the kidneys. It seems to be absorbed with difficulty if at all, from the stomach and bowel for it is not recovered from the urine.

It is used empirically as an **anti-emetic,** and especially for the vomiting from pregnancy, seasickness and other conditions in which gastric irritation is not the primary cause. It is not known how it acts in controlling emesis, but it is thought probable that its effects are local and similar to those of bismuth subnitrate. The pharmacopœial dose is often exceeded; 2 gm. (30 gr.) have been frequently given with good results. Cerium oxalate appears to have some action as a **sedative** to the gastric mucous membrane, and so may allay the pain of gastralgia or prove beneficial in dyspepsia occasioned by deranged innervation. In instances of cough, of doubtless reflex origin, when

associated with vomiting, it is sometimes of service. In chronic diarrhœa it may be used in the place of bismuth salts in the same dosage as the latter.

Drugs Acting on the Intestines

(*a*) **Laxatives.**

HONEY

For the Preparations of Honey *see* p. 245.

Action and Therapeutics of Honey

Honey is demulcent, nutritive and slightly **laxative.** Generally it constitutes an agreeable article of diet but in some individuals, however, it causes pyrosis, flatulence and colic, and in others an eruption of urticaria.

It is useful in relieving dryness of the mouth and facilitating swallowing, and with 60 per cent. of acetic acid, it is a pleasant addition to gargles. Honey is sometimes a sufficient laxative for the constipation of children.

MANNA

For the Preparations of Manna *see* p. 159.

Action and Therapeutics of Manna

Manna is aperient when taken in considerable quantities.

It is given as a **mild laxative** to children. It dissolves easily in milk, and is pleasant to the taste.

CASTOR OIL

For the Preparations of Castor Oil *see* p. 160.

Action of Castor Oil

External.—Castor oil, like other bland fixed oils, is protective when applied to the skin and mucous membranes.

Internal. *Gastro-intestinal Tract.*—The so-called unpleasant taste of castor oil is mostly due to the smell, and if the nose is held when the oil is swallowed, it is less disagreeable. It is not irritant to the

stomach, upon which it produces no effects. When it reaches the intestine, however, it is saponified, forming sodium ricinoleate, which is more or less irritant, and glycerin and thus produces purgation by stimulation of peristalsis. Castor oil may be taken in very large quantities without producing any other effect than that of a simple **laxative.** It takes about five hours for castor oil to operate, which it does thoroughly, the stools from it being soft, but not liquid, and it does not usually cause griping. Even when rubbed into the skin, it is capable of acting on the bowels, and also when given by the rectum. A single dose is not followed by constipation, but this is very apt to result from the habitual use of the drug.

Therapeutics of Castor Oil

On account of the mildness of its action, castor oil is one of the most useful drugs whenever it is desired simply to evacuate the alimentary canal, for instance, for getting rid of undigested food that is causing diarrhœa. When irritating substances or hardened fæces are to be removed from the intestines it is the most efficient purgative compatible with safety. When inflamed hæmorrhoids, fissures of the anus or surgical operations on the pelvic viscera require the use of a certain, but mild and **unirritating, laxative,** castor oil should be selected. In the dysentery of children and the sporadic dysentery of adults, especially after the more acute febrile symptoms have subsided, an emulsion of castor oil made with mucilage of acacia, to which, tincture of opium (laudanum) may be added if the symptoms are severe, is generally of great service. It may also prove valuable in the entero-colitis of infants and young children. In these patients the amount of oil in each dose should be quite small. If given by the rectum it should be saponified by an alkali, otherwise it will act merely as a bland oil. With the exception of aspidium (*see* p. 339), castor oil is a good purgative to give before and after the use of anthelmintics. It is not suited for patients suffering from chronic constipation.

As most persons object to taking castor oil by itself, it is generally necessary to disguise its taste in some way. It may be given in soft capsules, which can be obtained of any desired size. If for any reason these are objectionable, it is best administered in the beverage known as "sarsaparilla", which is carbonated and the oil poured upon

it without coming into contact with the edge of the glass, and ingested without stirring the contents of the glass. Lemon juice or coffee conceals the taste to some extent, and the following is recommended as a good way in which to take it: The oil is added to 4 mils (1 fl. dr.) of peppermint water, and then a little brandy added till the oil neither sinks nor floats. If the inside and rim of the glass are moistened with the vehicle, the oil, which should be kept without agitation if possible, between the two layers of the vehicles, is scarcely tasted. Castor oil with balsam of Peru (*see* p. 337) makes an excellent surgical dressing which is applicable for burns, wounds, abscesses, and many other conditions.

(*b*) **Simple Purgatives.**

ALOES

For the Preparations of Aloes *see* p. 164.

Action of Aloes

External.—Aloes has no action on the unbroken skin, but is slightly stimulating to denuded surfaces. Powdered aloes, dusted upon an abrasion, blister or ulcer, is capable of being absorbed and producing the characteristic internal effects of the drug.

Internal. *Gastro-intestinal Tract.*—Like other substances having a bitter taste, aloes, in small doses, acts as a gastric stimulant. It is mildly irritant in the intestine and therefore does not produce inflammation. Its main action is shown in the **stimulation** of the **large intestine,** particularly the rectum, and the result of this is chiefly muscular contraction, though some increase of secretion is also produced by it. The presence of bile in the intestine is necessary to elicit its full effects, and it is believed itself to cause some **increased secretion of bile,** as indicated by the dark character of the passages from it. If bile is absent its purgative action can be increased by the addition of an alkali. If given alone it usually causes a considerable amount of griping pain. Aloin is regarded as less certain in its purgative action than aloes, and it is believed that the crystalline aloin itself is less active in the bowel, but is there changed under certain conditions to some compound which has irritant effects. It is stated, however, that a warm solution of aloin will produce purgation if injected subcutaneously.

Pelvic Organs.—Aloes produces a marked congestion of the pelvic organs, and is therefore regarded as an **emmenagogue.**

Excretion.—It is readily absorbed, and is eliminated through the bowels and kidneys, and also in the milk. It is quite likely that the habitual use of the drug will result in irritation of the kidneys.

Therapeutics of Aloes

As it usually requires from twelve to fifteen hours, or more, to act on the bowels, it is customary to administer it comparatively early in the evening in order to secure a movement from it, in convenient season, on the following morning. On account of the griping which it is apt to cause if employed alone, it is usually associated with carminatives or other agents calculated to promote greater regularity of peristaltic contraction. A small amount of extract of hyoscyamus or belladonna generally answers very well. The bitter taste of aloes is of service in aiding digestion, and a very good dinner pill is composed of 0.06 gm. (1 gr.) of extract of aloes and 0.015 gm. (¼ gr.) of extract of nux vomica. If the fæces are very hard, 0.03 gm. (½ gr.) of powdered ipecac should be added. Such a pill, with the addition of 0.12 gm. (2 gr.) of ferrous sulphate is often very useful in anæmia. For chronic **constipation,** especially in children and also in persons of middle age, generally due to an imperfect contraction of the muscular coat of the large intestine, aloes is an efficient purgative. If given in moderate doses, it has the advantage of not producing subsequent constipation, and, in addition, of seldom requiring an increase in the dose. Simple jaundice, or at least a bilious state, in which the tongue is coated, the breath foul, the abdomen tumid, and the colon impacted, may usually be successfully treated with this remedy. The constipation of hypochondriasis and melancholia also is best overcome by the use of aloes, and, with the removal of the impacted fæces, there is not infrequently an improvement in the mental state. In hysteria, with anæmia and constipation, it may be combined with asafetida, which has also a carminative effect. Combined with iron and myrrh, aloes is used to a considerable extent in the treatment of amenorrhœa, whether associated with chlorosis or not. Although it is generally believed to induce hyperæmia of the pelvic organs, it seems quite possible that the relief by it of the constipation which is so commonly present in these patients is largely, if not chiefly, responsible for the improvement which frequently takes place under its use. The presence of hæmorrhoids has been regarded as another

contra-indication, but if a patient suffers from hæmorrhoids which are not inflamed, aloes can be safely administered, and even with marked benefit, if they are due to a relaxed rectal mucous membrane. It is stated that aloes is contra-indicated in instances of menorrhagia. This is no doubt true as regards full-blooded subjects, but when this condition occurs in the debilitated and relaxed, it is sometimes relieved by the drug. As to the risk of employing it in pregnancy, lest the fullness of the uterine vessels induced by it may lead to abortion, it would appear doubtful whether the danger from aloes in this respect is greater than that from any other active cathartic. As the purgative principle of aloes is excreted to some extent in the milk, the drug should be given with caution in nursing women, on account of the danger of its causing diarrhœa in the infant.

RHUBARB

For the Preparations of Rhubarb *see* p. 160.

Action of Rhubarb

External.—Rhubarb if ever used for external application, would give rise to a mild irritation in consequence of its chrysarobin, which by itself excites inflammation of the skin.

Internal. *Alimentary Canal.*—In the mouth, rhubarb slightly increases the salivary secretion. In moderate doses by reason of its bitter principles it increases gastric secretion, peristalsis, vascularity and absorption, and thus promotes digestion. In larger doses it has a **purgative** action, producing in from four to eight hours, generally with some griping, a soft, though not watery, evacuation which is of a yellowish-brown color, due to the chrysarobin. The purgative properties of the drug are due to the irritant anthracene bodies (*see* p. 160) which it contains; chrysarobin is stated not to cause purgation, on account of its rapid absorption. Rhubarb has some cholagogue action but it is not sufficiently marked to entirely explain its purgative properties. It probably also increases the excretion of bile by accelerating its passage through the intestine and preventing its reabsorption. Rhubarb, as well as podophyllin and resin of jalap, is said to require the presence of bile in the intestine as a necessary condition for its operation, so that in its absence these drugs may be either altogether inactive or much less energetic than usual. It is

stated, but without satisfactory proof, that rhubarb affects chiefly the muscular coat of the intestine, and thus purges by increasing peristalsis. The purgative action is succeeded by constipation, due to the astringent effect of the rheotannic acid. This is presumably absorbed quickly and subsequently re-excreted into the bowel, for were it not rapidly absorbed it would be swept away in the evacuations and would have no opportunity of producing its astringent action.

Kidneys.—Rhubarb has the effect of slightly increasing the amount of urine. The excretion of chrysaphanic acid gives a yellowish color to this fluid, and also to the milk of nursing women.

Skin.—The skin may also assume a yellowish tinge from the presence of chrysaphanic acid, and rarely cutaneous eruptions are produced.

Therapeutics of Rhubarb

Rhubarb is an excellent **purgative** for the indigestion of children whether attended by diarrhœa or not, as it efficiently clears the intestinal canal of undigested food and irritating secretions, and its after-astringent effects often serve a very useful purpose. The aromatic syrup combined with an alkali is especially serviceable in the summer complaints of children when the stools are greenish and mucous. Rhubarb is much used in diarrhœa, with intestinal relaxation, to clear the bowels of acrid secretions. In small doses, the tincture is a good stomachic tonic in dyspepsia with deficient biliary and intestinal secretions. On account of the griping which it is apt to occasion, rhubarb should rarely be prescribed alone. Notwithstanding its astringent property, rhubarb is largely used as an habitual laxative, as it not only does not impair, but improves the appetite and digestion. It should not be given in a sthenic state of the system, with hyperæmia of the mucous membrane, nor when depletion is necessary. For the treatment of constipation, however, it has the disadvantage of requiring to be frequently repeated, its astringent after-effect being in many cases a decided objection. The compound rhubarb pill is a mild and efficient preparation for moving the bowels. It is often combined with calomel to act upon the so-called torpid liver, as in Quain's pill, which is calomel, 0.06 gm. (1 gr.) with compound rhubarb pill; 0.20 gm. (3 gr.).

CASCARA SAGRADA

For the Preparations of Cascara Sagrada *see* p. 163.

Action of Cascara Sagrada

The fresh bark is emetic, but after it has been kept for about two years this action is lost. Cascara sagrada is a **simple,** but efficient, **purgative,** which does not occasion much griping. One of the advantages of this drug is that it overcomes constipation without purging, and consequently without prostration, and the stomachic properties, which it derives from its bitter principle, add to its value by improving the appetite and digestion.

Therapeutics of Cascara Sagrada

Cascara sagrada has established itself as a favorite and reliable remedy in **habitual constipation.** It should not be employed as a purgative when a powerful impression is required. It does not operate urgently, like many purgatives which produce watery stools, and is best suited to instances of simple constipation, or of torpor of the colon without associated disease. It may be given for the relief of catarrhal jaundice, as well as of hæmorrhoids and affections of the pelvic organs, and is often very useful in instances of dyspepsia accompanied by constipation. A special virtue of cascara sagrada is, that in its continued use, gradually increasing doses are unnecessary. As the condition improves the daily quantity may be reduced, and a considerable number of instances of chronic constipation are eventually cured by the drug. As the fluidextract is very bitter, it is advisable that its taste should be concealed by aromatics, or by licorice, or it may be administered in chloroform water, or with fluidextract of eriodictyon which lessens the appreciation of the bitter taste; the latter should be held in the mouth for some minutes before the cascara sagrada is taken. The aromatic fluidextract is very satisfactory in that it is less bitter and not so provocative of griping.

FRANGULA

For the Preparations of Frangula *see* p. 163.

Action and Therapeutics of Frangula

The fresh bark is a violent gastro-intestinal irritant, but that which has been kept a year is a **purgative,** acting like cascara sagrada. It

is said to contain amygdalin similar to that of bitter almond and possibly free hydrocyanic acid in minute quantity, but this is doubtful.

The fluidextract, in small doses, is suitable for children, and is useful in **chronic constipation.** In large doses it is chiefly employed by veterinarians.

SENNA

For the Preparations of Senna *see* p. 162.

Action of Senna

Senna is the last of that class of drugs, which includes aloes, rhubarb, cascara sagrada, and frangula and are known as the **anthracene purgatives,** because they owe their activity to the presence of irritant anthracene ($C_{14}H_{10}$) compounds, of which only a few have as yet been isolated. Senna differs from rhubarb in the absence of any astringent property, and its use is not followed by constipation. It is somewhat more liable to induce **griping** and nausea than rhubarb. Generally five or six hours elapse between its administration and the first action of the bowels, and the stools resulting from it are watery and of a pale yellow color. Senna has little or no action on the secretion of bile. The cathartinic acid in it is supposed to stimulate the muscular coat of the intestine, especially the colon, occasioning some hyperæmia, and, in consequence, the contents of the small intestine are hurried through the lower bowel, so that some undigested food may appear in the motions. Some state that senna acts directly as a stimulant upon the mucous membranes, and so produces a local peristalsis as it is moved along. It will cause purgation, however, if it is injected into the circulation, and this is probably because cathartinic acid is excreted into the bowel. While this acid is by far the most important purgative principle of senna, there is reason to suppose that there are other substances, as anthracene, in it of like action. Some constituents of the drug are absorbed and the chrysarobin, which it contains in small amount, may cause discoloration of the urine, staining it carmine if that fluid is alkaline, or yellow if it is acid. The purgative properties of the drug may be imparted to the milk of nursing women, and therefore senna should be used with caution for these patients.

Therapeutics of Senna

Senna is a safe and **reliable purgative** for simple constipation, but is usually combined with other remedies. As it acts largely upon the

colon, it is serviceable in slight cases of fæcal accumulation. It is useful to complement the action of duodenal purgatives, and an illustration of this is seen in the old prescription of blue mass (*see* p. 290) at night and the compound infusion, which contains also manna and magnesium sulphate, in the morning. The latter is very disagreeable, however, so that the compound glycyrrhiza powder is preferable. In patients when cascara sagrada alone will not move the bowels, senna is sometimes combined with it with good effect. Coffee has been recommended for masking the disagreeable taste of senna; 4 gm. (1 dr.) of senna and the same quantity of coffee may be infused in 90 mils (3 fl. oz.) each of hot milk and boiling water and the whole taken at once.

PHENOLPHTHALEIN

For the Preparation of Phenolphthalein *see* p. 107.

Action and Therapeutics of Phenolphthalein

It is a decidedly insoluble substance which in ordinary amounts when given internally has no other physiological effect excepting a **laxative** one. In large and repeated doses it is believed to cause nausea and later intestinal catarrh and irritation of the kidneys, although no phenol is found in the urine. If given hypodermatically, phenolphthalein itself may appear in the urine, which if alkaline, even traces of it will show a pink coloration.

It has had an extensive use as a mild, **pleasantly acting laxative** producing large passages of fæcal matter due partly to delayed absorption but more probably from increased peristalsis. As it is very slightly absorbed, if at all, no depression is produced.

OXGALL

For the Preparations of Oxgall *see* p. 245.

Action and Therapeutics of Oxgall

Oxgall, when added to albuminous solutions, delays their decomposition. It aids in the absorption of fats. If given by the mouth it is mostly absorbed from the intestine and acts as a **cholagogue.**

It has been used as a cholagogue purgative, frequently associated with aloes. Although theoretically of value in replacing deficient biliary secretion, it has the disadvantage of disturbing the gastric digestion. It may be found useful, however, when given as an

enema in instances of impacted fæces when the rectum will retain a bulky injection. For this purpose 30 gm. (1 fl. oz.) of oxgall in 500 mils (1 pt.) of water should be used.

(*c*) **Drastic purgatives.**

SCAMMONY ROOT

For the Preparations of Scammony Root *see* p. 165.

Action and Therapeutics of Scammony Root

Scammony root is a **hydragogue cathartic** of rapid and energetic action. It has no effect until it enters the duodenum, and the presence of the bile appears to be essential for its activity. With the aid of the bile it powerfully **stimulates** the **intestinal glands** to increased secretion, and incidentally causes more or less hyperæmia of the bowel and stimulation of its muscular coat. In about four hours after its administration a profuse watery evacuation occurs, and its action is attended with considerable griping. In over-doses it is likely to cause violent gastro-enteritis and colitis. If absorbed it may irritate the kidneys and even produce an acute nephritis. No purgative effect is produced when it is injected subcutaneously or intravenously.

As it is a prompt and efficient cathartic, scammony root may be used in instances of **obstinate constipation** and impaction of fæces. On account of its violent properties, however, it is usually best to combine with it some carminative or less active purgative. It is often serviceable in the treatment of dropsical effusions and as a derivative in cerebral affections, and is well adapted for severe mania and hypochondriasis. For dropsy the compound jalap powder is more commonly employed, but, when this fails to act, recourse may be had to scammony root. It is efficient in clearing mucus from the intestines, and is anthelmintic against both round-worms and tapeworms, but this remedy is unnecessarily severe for children.

JALAP

For the Preparations of Jalap *see* p. 166.

Action and Therapeutics of Jalap

The action of jalap is very much the same as that of scammony, but it is somewhat less powerful and produces rather less colic, while it promotes even greater **intestinal secretion.** It has been credited by some observers with diuretic properties. Jalapurgin, its glucoside, not official, administered by the mouth cannot be detected in the fæces or urine, and is therefore supposed to undergo oxidation in the body.

Jalap is occasionally employed for severe constipation, and an old prescription, known as Rush's thunderbolt, consists of equal parts of powdered jalap and calomel, well triturated, in dose of .60 gm. (10 gr.). Curiously enough, this does not gripe. The principal use of jalap is in the treatment of all forms of **dropsy**, and particularly that from Bright's disease. For this purpose the compound powder, containing potassium bitartrate, which produces abundant watery evacuations, is commonly employed, and while the **diuresis** which also is frequently observed after its administration may possibly be due in a small measure to the effect upon the kidney of the jalap itself, the action of the potassium bitartrate and the relief of the engorgement of renal vessels, resulting from the drain of fluid from the intestinal vessels, would seem to be important factors in the augmentation of the urine. Jalap should not be employed for too long a time continuously, since it may occasion gastro-enteritis and, in addition, may result in cardiac weakness. It is sometimes found to be of service in various forms of cerebral congestion. The drug is naturally contra-indicated in all inflammatory states of the alimentary canal, and large doses of it should be given with caution.

GAMBOGE

For the Preparations of Gamboge *see* p. 169.

Action and Therapeutics of Gamboge

Gamboge belongs to the class of drastic or hydragogue cathartics, and is **violent** in its action, causing marked irritation of the alimentary canal, **energetic peristalsis**, with considerable griping, and greatly augmented intestinal secretion. It owes its activity to gambogic acid, which, however, is insoluble, and seldom acts unless it is accompanied with the inert bodies of the crude drug. Most of it escapes unaltered in the stools, but some is absorbed, and small and repeated doses are slightly diuretic. It colors the urine yellow.

As its action is somewhat uncertain, and is so **violent** and apt to cause **severe colic** when it does take place, gamboge is not often prescribed, except as the compound cathartic pill of which it is one of the constituents. Gamboge is irritant to the stomach, so that it should always be administered in pill form, and always in combination with other remedies. It is quite an efficient anthelmintic, and is occasionally given with other agents of this class.

COLOCYNTH

For the Preparations of Colocynth *see* p. 168.

Action of Colocynth

External.—Colocynthin is irritant to mucous membranes, especially those of the eye, nose and throat.

Internal.—The action of colocynth varies in accordance with the amount given and the mode of administration. In small doses it acts as a simple **bitter**, increasing appetite and gastric secretion. In larger doses it is a **powerful intestinal stimulant**, augmenting the biliary and intestinal secretions, and accelerating the movements of both the large and small intestine. It occasions considerable griping, but the amount of colic does not seem to be entirely dependent upon the quantity taken, as even small doses may be followed by much discomfort if the drug is given alone. It produces abundant watery passages, and, if the dose is excessive, may set up enteritis, with bloody stools. Toxic symptoms are not infrequently met with from the use of colocynth, as it is one of the drugs occasionally employed for the purpose of producing abortion. It appears to have a distinct diuretic action, for colocynthin is stated to excite renal irritation or inflammation when it is given either hypodermatically or by the mouth, and even when the powder is inhaled during its manufacture. This resinous glucoside, not official, not only purges when swallowed, but also when administered subcutaneously or by intravenous injection. Applied to the skin of the abdomen, colocynth causes intestinal pain and some purgation.

Therapeutics of Colocynth

Colocynth is perhaps the most generally useful of the **drastic cathartics**, but it is of great importance that it should be administered in carefully regulated doses and properly combined with other remedies. The violence of its action may be moderated by its administration with aromatic substances or with intestinal sedatives such as belladonna or hyoscyamus. The compound extract is a safe, effective, and not unpleasant preparation for the relief of constipation, and the compound cathartic pill is also a very serviceable combination. For some instances of **habitual constipation** the compound extract, combined with the extract of physostigma, is satisfactory. In cerebral congestion the preparations of colocynth are

employed for their revulsive effect. Hypochondriasis and melancholia, when associated with sluggishness of the large intestine and fæcal accumulations, are benefited by colocynth, as by other hydragogue cathartics. Notwithstanding its diuretic action even in health, colocynth is not so generally serviceable in the treatment of dropsy as jalap. Like other remedies of its class, it is contra-indicated in inflammatory states of the intestinal canal. It is often stated that colocynth is unsafe during pregnancy, but there seems to be no good reason for this assertion, provided the remedy be administered with due caution. Some obstetricians are in the habit of prescribing it with discretion, often with hyoscyamus and nux vomica, when required during pregnancy. Colocynth in combination with colchicum is found in some of the popular remedies for gout.

ELATERIN

For the Preparation of Elaterin *see* p. 168.

Action of Elaterin

The action of elaterin closely resembles that of colocynth, but is much more energetic, and it is regarded as the **most powerful hydragogue cathartic known.** The drain of fluid which it induces even in medicinal doses is so profuse that its use is commonly attended with considerable prostration. When externally applied, it is said, as well as when it is injected into the circulation, it also produces a purgative effect. If given in properly regulated amounts, it occasions comparatively little pain or irritation, notwithstanding the very free catharsis caused.

Therapeutics of Elaterin

On account of the violence of its action, elaterin is not adapted to instances of ordinary constipation. It is the most efficient of the hydrogogue cathartics in general dropsy or in ascites, and its practical value in uræmia has been demonstrated by clinical experience. The great drawback to its use is the depression resulting from it, and hence great care should be exercised to administer it in not too large doses, and it may be advantageously followed by alcoholic stimulants. It ought never to be given in instances of marked exhaustion, and its injudicious use in the later stages of dropsical affections may induce fatal collapse. It should always be administered with the greatest

caution, if at all, in disease of the heart, but under proper restrictions it may be employed for the effusion in pericarditis, as well as in pleurisy. In cerebral congestions or effusions and in other affections of the brain it is valuable as a derivative. Elaterin has been employed in various diseases for the purpose of depletion, but to accomplish this, the salines are usually preferable, especially if there is present any gastro-intestinal irritation or inflammation.

CROTON OIL

For the Preparation of Croton Oil *see* p. 167.

Action of Croton Oil

External.—Croton oil is an **irritant** of extraordinary power. A single drop, owing to the contained crotonoleic acid, applied to the skin causes pain, hyperæmia and prompt vesication. The vesicles thus formed rapidly undergo **pustulation,** while the surrounding tissue becomes inflamed and œdematous. The pustules may be umbilicated, but differ from variolous pustules in that they vary greatly in their size.

Internal.—On the alimentary tract croton oil exerts its irritant action, but it is found that if the free acid in it is removed, this irritant effect will be diminished but still it possesses a much more energetic purgative action than castor oil. Croton oil, then, not only owes its activity to free crotonoleic acid but also to this as a glyceride which is slowly decomposed in the intestines. Ordinarily it is such a **powerful irritant** that except in the smallest doses it produces marked gastro-enteritis, with nausea and vomiting, severe abdominal pain, violent purging, with bloody stools, collapse and death. One drop of it will cause considerable colic and in the course of one or two hours an evacuation of the bowels, followed by others, the passages becoming more and more fluid. At the same time there are produced hyperæmia of the gastro-intestinal tract, increase of secretion, and probably increased peristalsis, due simply to the irritation or to some action of the drug exerted after absorption. As to what becomes of croton oil in the body nothing is positively known, but it is probable that part of it is excreted into the large intestine. Its external use may cause free purgation.

Therapeutics of Croton Oil

External.—Croton oil was formerly employed to produce counter-irritation, especially in diseases of the chest and of the joints, but is not often used for this purpose now, at least in an undiluted state, as in many instances permanent cicatrices resulted. In very obstinate ringworm, which has resisted other remedies, croton oil is sometimes applied to a small area, but it should never be used for such purposes in delicate children.

Internal.—The chief advantages of croton oil are its rapid action as a **drastic cathartic** and the smallness of the dose required. It is therefore of great value for patients who are unconscious, rebellious or maniacal, and it is used to a considerable extent in cerebral apoplexy, uræmia and puerperal eclampsia. As a revulsive in cerebral congestion it may be of service by increasing vascular dilatation in the bowel, and thus lowering the intra-cranial blood-pressure. It is unsuitable for the treatment of dropsy or of other conditions requiring frequency of administration, as its action may be followed by considerable irritation. In fæcal impaction when there is no organic intestinal obstruction a dose of croton oil often acts very happily. The constipation due to lead poisoning may not infrequently be overcome by it after less energetic cathartics have failed. It is contra-indicated in all feeble persons, in pregnant women, and in patients suffering from hæmorrhoids, peritonitis, or affections of the alimentary tract, or of the kidneys, and as a rule, should be avoided in children.

TOXICOLOGY

Symptoms.—These have already been described. Fortunately, when an overdose is swallowed, vomiting is usually very promptly excited, and hence very large quantities have been taken without producing a fatal result.

Treatment.—If free emesis has not been caused by the drug the first step in the treatment, of course, would be to evacuate the stomach. Opium should be given to lessen the purging and demulcents for the irritation. Cardiac stimulants hypodermatically and external heat are required should collapse supervene.

PODOPHYLLUM

For the Preparations of Podophyllum *see* p. 169.

Action of Podophyllum

External.—Podophyllum is irritant to the skin and mucous membranes, and from denuded surfaces it may be absorbed and produce a purgative effect.

Internal. *Gastro-intestinal Tract.*—Podophyllin, its resin, is a **drastic purgative.** Large doses cause gastro-intestinal irritation, and have been known to prove fatal from acute inflammation of the bowel. Medicinal doses occasion considerable colic and in some instances nausea. Podophyllin resembles aloes in the **slowness** of its action, catharsis rarely occurring earlier than ten hours after its administration, and sometimes not for twenty-four hours. The watery passages which it produces are stained dark by the presence of bile. In small doses it probably increases the secretion of that fluid; at all events, under its action there is an augmentation of the solids in it. When it is given in purgative doses the quantity of bile is said not to be increased, though more of it is emptied from the gall bladder into the intestine. Podophyllin in times past has been believed to act both as a direct and indirect cholagogue. An old name for this drug is Vegetable Mercury. Podophyllin causes purgation when injected subcutaneously, and this is probably because, after absorption, it is excreted into the bowel, since it has been detected in the fæces when administered in this way.

Therapeutics of Podophyllum

As podophyllum is believed to act especially on the liver, it is quite largely employed in **constipation** with **hepatic derangement,** and particularly in so-called bilious attacks. In congestion of the portal circulation, in catarrhal and malarial jaundice, and in ascites it generally acts with great efficiency, and hæmorrhoids of recent formation which bleed in consequence of stasis in the portal circulation, may sometimes be cured by a brisk cathartic dose of podophyllum. Habitual constipation due to inactivity of the muscular coat of the intestine may also be cured by the nightly use of a small dose of the resin, known as podophyllin, combined with belladonna. It should not be given in association with promptly acting purgatives, as with them it will be carried through the bowel before it has had time to produce its effects. It may often be advantageously combined with hyoscyamus to prevent griping. The only preparation that should be employed is the resin and this is almost universally administered in pill form.

COLCHICUM

For the Preparations of Colchicum *see* p. 170.

Action of Colchicum

External.—Colchicum is a decided local irritant, causing redness and smarting when applied to the skin, while the powder, when inhaled, excites sneezing and conjunctival hyperæmia, with a burning sensation in the mouth and throat.

Internal. *Gastro-intestinal Tract.*—In the great majority of instances, moderate doses of colchicum give rise to no appreciable effect. In some individuals, however, there is produced after a time a feeling of malaise, with discomfort in the stomach and bowels, followed by some nausea and diarrhœa. It may also have the effect of slightly increasing the biliary secretion. In large amounts it causes salivation and nausea, with **violent vomiting and purging,** and afterwards a condition of depression, apathy, and sometimes an ascending paralysis and collapse. It would appear that the violent symptoms of gastro-intestinal irritation do not indicate an enteritis since the intestine may appear quite normal after death, and there is seldom more than a simple catarrh of the duodenum. When ecchymoses have been found, they have been ascribed to the mechanical effects of the extremely energetic peristalsis occasioned.

Circulation and Respiration.—The pulse may become small, rapid and thready, and this is no doubt simply the result of the collapse. The respiration is found to be slow, though deep and full at first; later it becomes shallow, and death is due to failure of the respiratory center the heart continuing to beat for some time afterward.

Nervous System.—The action on the central nervous system is almost purely depressant, but it is believed that the symptoms caused are probably secondary to the effect upon the abdominal organs, rather than due to any direct central action. The consciousness and intelligence as a rule remain unimpaired, though there is generally some giddiness. In exceptional instances there is more or less confusion, and even delirium may precede the collapse.

Kidneys.—In some instances the urine is slightly increased, while in others complete anuria, lasting for many hours, is produced. According to the latest researches, small quantities of colchicine, its alkaloid, increase the amount of both the urea and uric acid, as well as of the fluid, while under larger doses the quantity is diminished, the urea and uric acid being less affected than with the smaller ones.

Therapeutics of Colchicum

Colchicum has long been used empirically in the treatment of **gout**, now it is not so universally employed. As the pathology of the disease remains uncertain, it can only, like other medicines, be used in its treatment in an empirical manner; but in a considerable proportion of instances its administration is attended with decided benefit. In these, if given in suitable quantities during the attack, it markedly relieves the pain, while in smaller doses between the attacks it seems to lessen their severity. In certain instances, also, where headache, neuralgia, dyspepsia, neuritis, eczema, conjunctivitis, bronchitis and various other ailments recur in gouty subjects, it is found useful. The alkaloid colchicine, especially in combination with methyl salicylate, is believed by some to be more successful in gout than any form of the crude drug. Colchicum is used to some extent in the treatment of chronic rheumatism and so-called rheumatoid arthritis, and here, as well as in subacute or chronic gout, it is advised that it should be given in conjunction with potassium iodide. In gout the commencement of the treatment with a purgative is usually advisable, and it is also a common practice to administer colchicum with magnesium sulphate. To elderly persons and to those whose circulatory apparatus is feeble it is advised that colchicum should be administered with caution, or not at all. Moreover, some individuals exhibit an intolerance of even very small doses, which quickly produce intestinal irritation or cardiac depression. It is found that the paroxysms of gout may often be suppressed by large purgative doses, but experience has shown that this use of the drug is dangerous, as such suppression is liable to be followed by serious internal disease.

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Treatment.—In colchicum poisoning an emetic and a cathartic should be administered at once, if the stomach and bowels have not been freely evacuated. Large quantities of warm water may also be given to aid in these operations and to act on the kidneys. Tannic acid is a chemical antidote, forming an insoluble tannate with the alkaloid, and it should be administered in large amount. Otherwise the treatment must be symptomatic. Opium is usually required to relieve the pain and check vomiting and diarrhœa, and in addition, stimulants to counteract depression.

(*d*) Intestinal Antiseptics.

BETANAPHTHOL

For the Preparations of Betanaphthol *see* p. 109.

Action of Betanaphthol

This substance in solution or in vapor is **irritant** to mucous membranes, and in the course of excretion induces pain in the bladder and urethra, with strangury, and hyperæmia and swelling of the mucous membrane. Either when injected subcutaneously or absorbed from the alimentary canal, in sufficient quantity, it excites acute nephritis, with albuminuria and hæmoglobinuria. Nephritis of some degree of severity is said to have been caused from its external application.

Therapeutics of Betanaphthol

Betanaphthol was first introduced as an antiseptic in dermatological practice and used, as an ointment, in scabies, ringworm and psoriasis; it is, however, irritating in eczema. It is a remedy of value in obtaining **intestinal antisepsis,** bacteriological investigations showing that it destroys certain micro-organisms when administered to the extent of 2.70 gm. (40 gr.) a day. For this purpose the bismuth compound is preferable. As it is more or less irritating to the stomach it should be administered in keratin-coated pills when its action is desired in the intestine only. It is useful in chronic gastric or intestinal catarrh, and dilatation of the stomach. Next to thymol, it is a most valuable remedy for uncinariasis, 1 to 2 gm. (15 to 30 gr.) being administered daily. Good results have also been reported from its employment in typhoid fever, tuberculous ulceration of the bowels, scarlatina, diphtheria and erysipelas. Fatal inflammation of the kidneys has resulted in some instances where it has been used in large quantities.

RESORCINOL

For the Preparation of Resorcinol *see* p. 108.

Action and Therapeutics of Resorcinol

Resorcinol was originally introduced as an antipyretic, but is now seldom employed for this purpose, as the necessarily large doses are too depressant to the heart. It is powerfully **antiseptic.** Dark-colored urine, often described as smoky, is sometimes seen after large doses.

A solution of resorcinol in glycerin (1 to 4), is a good application for removing epidermic scales in chronic skin diseases and in seborrhœa sicca of the scalp; here it doubtless inhibits the action of the bacteria which may be the cause of dandruff. A lotion of resorcinol, 1; ether, 1; castor oil; cologne, 10; alcohol, 35, may be used both for dandruff and alopecia. A 5 per cent. solution of resorcinol is an excellent antiseptic injection for the bladder in cystitis.

Internally this remedy is of great value in **fermentative** gastric **dyspepsia** when administered, well diluted, one hour after the ingestion of food. The daily amount should be at least 1.50 gm. (22 gr.). In combination with tincture of nux vomica it improves the digestion and relieves the gastric symptoms of neurotic individuals who suffer from what was formerly called nervous dyspepsia.

SALICIN AND THE SALICYLATES

For the Preparations of Salicin and the Salicylates *see* p. 155.

Action of Salicin and the Salicylates

External.—Salicylic acid is somewhat more powerfully **antiseptic** than phenol, but its salts are less strongly antiseptic. Salicin, it is stated, has no antiseptic properties unless decomposed into its constituents. Applied to the skin, salicylic acid has the effect of softening the epidermis and also of **diminishing perspiration.** It is irritant to mucous membranes and abraded surfaces, and its continued application in concentrated form has some destructive action on the tissues. When inhaled it excites sneezing and coughing.

Internal. *Alimentary Tract.*—When swallowed in powder, salicylic acid causes irritation, and sometimes soreness, of the mouth and throat. In the stomach it is also irritant, and is apt to cause pain, nausea and vomiting, with more or less congestion. In some instances even erosion of the mucous membrane is produced. In dilute solution, however, it has no such effect, although the action of the digestive enzymes may be retarded. Salicin is a bitter tonic, instead of an irritant to the stomach, though after absorption its action is similar to that of the acid. The sodium salt is also much less irritating than salicylic acid. In the body salicin, when given by the mouth, is decomposed into glucose and saligenin, and this process without doubt takes place in the intestine, for when it is injected into the circulation it is chiefly excreted unchanged. Saligenin is

further decomposed into salicylic acid, salicylous acid or salicylic aldehyde, and salicyluric acid.

Liver.—Salicylic acid and the salicylates **increase the biliary secretion,** both the amount of bile and the solids, through some specific action, it is thought, on the liver cells, and they are probably the most **reliable cholagogues** known.

Heart and Circulation.—It has been shown by sphymographic tracings that full doses of sodium salicylate (5 gm.—77 gr.—in two doses of 2.5 gm.—38½ gr. each, given in water with an interval of one hour possess a raising, rather than a lowering, action upon the intra-arterial blood-pressure and the frequency of the pulse. In febrile conditions, some of which were rheumatic, the continued use of the drug in doses of 2 to 4.5 gm. (30 to 70 gr.) *per diem* did not produce any appreciable depression. The depressing effect of salicylates upon the heart which has sometimes been observed clinically may, it is thought likely, have been due to impurities in the drug, since it has been shown that creosotinic acid, which may in rare instances contaminate the synthetic acid, is a powerful cardiac poison.

Blood.—It is now known that salicylic acid, which is readily absorbed, exists in the blood as the salicylates of the alkalies. By some it has been found to be taken from the blood by the synovial membranes and rapidly excreted into the cavities of the joints. If this is the fact, it would thus be capable of exercising a specific action in **acute rheumatism.** The number of leucocytes in the blood is increased.

Respiration.—Acceleration of the respiration and dyspnœa are occasionally observed, and such results have been attributed to a central action.

Temperature.—Medicinal doses have no influence on the normal temperature. Very large quantities, by producing collapse may bring about some reduction in it. In fever, however, a distinctly **antipyretic** action is often observed, though the fall in temperature is usually smaller and of shorter duration than that caused by drugs of the acetanilid series. This action has been attributed to dilatation of the cutaneous vessels and an increase in the output of heat. Salicylic acid and salicin are **antiperiodic.**

Skin.—It has been shown by plethysmographic measurements that the vessels of the skin are dilated by salicylic acid in the same way as by the antipyretics, and this action is supposed to be due to

excitation of the vaso-dilator centers in the medulla which control the cutaneous areas. Probably the reason that such dilatation does not cause any reduction of the normal temperature is that it is counterbalanced by an increased heat formation. In some individuals skin eruptions of various character, possibly due in great measure to the dilation of the cutaneous vessels, are observed, but they occur less frequently than under the use of the antipyretics. The perspiration, which so often follows the administration of salicylic acid and its salts, is due rather to increased activity of the sweat centers than to the vascular dilation.

Nervous System.—Except where a special idiosyncrasy is present, the effects of salicylic acid on the central nervous system are unimportant. In large doses the organs of special sense may be affected (*see* p. 675).

Kidneys.—Salicylic acid has a moderate diuretic action, probably increasing the urinary secretion by its irritating effect on the renal epithelium. The increased formation of urea, due to increased metabolism, may also be a factor in the diuresis. Nephritis, with albuminuria and hæmaturia, has occasionally been observed. An increase in the nitrogen and sulphur of the urine is caused by salicylic acid, indicating a considerably augmented decomposition of the proteids of the body. There is also a very marked increase in the excretion of uric acid, different observers estimating this at from 30 to 100 per cent. Salicylic acid is rapidly absorbed from the stomach and duodenum and first appears in the urine in from ten to thirty minutes after ingestion. It is excreted by the kidneys to some extent unchanged, but for the most part in combination with glycocoll. The compound thus formed, salicyluric acid, is analogous to hippuric acid. It reduces Fehling's solution, and has been mistaken for sugar. The color of the urine is often dark or greenish in consequence of the presence of pyrocatechin or indican, or both. Under the use of salicylic preparations the normal acidity of the urine is increased, and alkaline urine may become acid. It acts as an **antiseptic** to the mucous membrane of the urinary tract, and urine will remain undecomposed for a considerable time after it has been passed.

Salicylic acid has been found in the milk, bile and perspiration. The action of methyl salicylate, obtained from oil of wintergreen or from oil of betula is the same as that of salicylic acid.

Salicylism.—In some individuals a train of symptoms analogous to those of cinchonism, and designated as salicylism, is produced by the use of salicylic preparations. The skin rashes have already been referred to. Perhaps the most frequent of the manifestations is deafness, generally with *tinnitus aurium*, and these disorders of hearing, as in the instance of quinine, have been shown to depend upon congestion of the tympanum, in which ecchymoses and even inflammation may be found. Such symptoms, it is well to note, may be relieved by the administration of a small amount of alcoholic stimulant fifteen minutes before each dose. The eye may also be affected; so that there may be dimness of vision, sometimes amounting to total blindness, in consequence, it is supposed, of constriction of the ocular vessels. Headache, with a sense of fullness, is also a common symptom, and this is very often associated with epistaxis. The patient is usually loquacious and delirium with hallucinations may supervene. In some instances hæmorrhages into the retina, from the mouth, intestine, kidney, or uterus likewise occur. Very large doses may produce depression of the circulation and respiration, vaso-motor paralysis and collapse. Abortion has been observed under salicylate treatment, but, as in the instance of quinine, it is considered a question whether this was due to the remedy or the disease for which it was administered. If the administration of the drug is continued, the disturbances of the circulation of the brain may produce violent delirium. Nausea and vomiting occur, and the pulse and respiration gradually become depressed. That some at least of these untoward symptoms, as well as others which are occasionally met with, may be due to impurities which are sometimes but rarely present in artificial salicylic acid, seems probable.

Therapeutics of Salicin and the Salicylates

External.—For external application salicylic acid has the advantages of being odorless and comparatively free from the danger of toxic symptoms following absorption. A 10 per cent. ointment may be used where an **antiseptic** and stimulating application is called for. Other useful extemporaneous preparations are a collodion (1 to 8) or a glycerite containing 10 per cent. of salicylic acid. Strong applications of salicylic acid are very serviceable for removing excess of epidermis, as in warts or corns, because it softens epithelium. The acid has a peculiar action upon the epidermis, and especially upon

the corneous layer; the horny cells are softened, gradually loosened and separated from the corium without any inflammatory reaction. What is known as "green solution," consisting of salicylic acid, 11; extract of cannabis, 2; flexible collodion, 87 parts; is often used for corns. Strong applications of the acid are also employed for the destruction of such growths as lupus nodules. Salicylic acid may be combined with chalk as a dentifrice, and with chalk, or starch, for checking profuse or fetid perspiration of the feet and axillæ and also the night-sweats of phthisis. This acid is the principal ingredient in Thiersch's solution (*see* p. 321), and a small amount of it is often added to Thompson's solution (*see* p. 321). In gangrene or sloughing ulcer it may be applied either in full strength or diluted, as seems advisable. On account of its germicidal activity it is efficacious in tinea circinata, and a solution of it in collodion is said to be a serviceable application for scabies, after the skin has been cleansed by a hot alkaline bath. An ointment containing it may be used to remove freckles, and for the treatment of chronic eczema, lupus erythematosus of the face and eyelids, and ulcerated lupus vulgaris.

Internal.—In many instances of **rheumatic fever** salicylic acid seems to act as a **specific.** Under its influence the temperature is rapidly reduced and the swelling and pain in the joints diminished, and it apparently has some effect in preventing the cardiac complications so frequently met with in this disease. In order to avoid gastric disturbance it should be administered well diluted. Sodium salicylate is frequently given, on account of its greater solubility, in preference to the acid itself. When this preparation is used, care should be taken that it is made either from natural salicylic acid or from artificial acid known to be free from impurities. In a well-marked attack of the disease it is customary to give 1.20 gm. (20 gr.) every three hours for the first day, or longer if there is not a satisfactory abatement in the symptoms. When this has been accomplished, the remedy, in the same dose, should be given three times a day, and continued for about ten days after the fever and pain have gone. Salicin, which is usually very well borne and is thought to be less depressant, is less certain in its effects, as its therapeutic activity probably depends upon its conversion into salicylic acid, and this process has been found to be a slow and imperfect one. The salicylic preparations are sometimes of service in chronic as well as acute rheumatism. They are of no benefit in rheumatoid arthritis. In gout their value is questionable,

some authorities advocating their employment and others believing them to be entirely inefficient. If given at all in this disease, very large doses often combined with colchicine or colocynth seem to be required, and even then no marked effect may be produced. For the glycosuria of patients affected with gout or goutiness they are distinctly useful. In many instances of migraine and sciatica the salicylates are of incontestible service, and their efficacy in such affections is explained by the action of these remedies in eliminating uric acid. So far as they limit intestinal fermentation they are also beneficial in diabetes. Excepting in rheumatic fever they are not usually employed as antipyretics, as in other febrile conditions the temperature can be more efficiently reduced, when this is desirable, by other means. In instances of alkaline urine and cystitis, salicylic acid has sometimes been employed to alkalize the urine, but there are better remedies for this purpose. In the treatment of **cholelithiasis**, sodium salicylate, in association with sodium benzoate, has been found very useful for the conditions which tend to cause intestinal catarrh and thus lead to catarrh of the biliary passages. Salicin, which, like other bitters, promotes appetite and digestion, may be employed as a stomachic in atonic dyspepsia. It has also been found useful in preventing the **fermentation** in gastro-intestinal catarrh, and as a remedy for the chronic diarrhœa of children.

The uses of methyl salicylate and of oil of gaultheria and oil of betula from which it is derived, are precisely the same as of salicylic acid, and are preferred to the synthetic acid by many clinicians.

PHENYL SALICYLATE

For the Preparation of Phenyl Salicylate *see* p. 157.

Action of Phenyl Salicylate

Phenyl salicylate is an **antiseptic**, germicide and antipyretic. It has little or no local action in the mouth or stomach, but in the intestine is decomposed by the fat-splitting ferment of the pancreatic juice into phenol, about 36, and salicylic acid, 64 per cent. It is thought that under certain conditions some decomposition also takes place in the stomach. The two **constituents**, thus set free, are absorbed and produce their **characteristic effects** on the system. It is excreted as phenol sulphonate and salicyluric acid. It is not generally toxic in therapeutic doses, but its too free use may give

rise to symptoms of phenol poisoning. In moderate quantities it sometimes produces the disturbances of hearing observed from salicylic acid, without any evidences of phenol intoxication. In large doses, however, the urine may indicate such poisoning or it may be excreted, by the intestines, unchanged.

Therapeutics of Phenyl Salicylate

External.—As an antiseptic for external use it has probably been overrated, as it is stated to be active only when decomposed by the microbes which it is designed to destroy. It has been used, mixed with starch (1 to 5), as a dusting powder, and as a dressing for wounds, burns and ulcers, as well as for erysipelas, impetigo, pustular eczema, and other cutaneous affections.

Internal.—In **rheumatic fever** it is used to some extent as a substitute for salicylic acid. Although somewhat slower in action, it has the advantage of being tasteless and of producing no gastric irritation. Occasionally, however, the considerable amount of phenol freed by its decomposition has induced troublesome symptoms. Since this takes place in alkaline fluids, it has been used as an intestinal antiseptic in **acute diarrhœa,** catarrh of the bile-ducts, dysentery, cholera and other diseases; also in affections of the urinary tract. It is a remedy of very great value in the treatment of **typhoid fever.** for by the active disinfection of the contents of the intestine and of the ulcerations, it favors their healing and prevents re-infection, thus lowering temperature and diminishing the liability to relapse and to permanent damage to tissues. On account of the phenol which it contains, this drug is more dangerous than the corresponding amount of salicylic acid, and it is especially to be used with great caution if the kidneys are diseased. Sometimes, in fever, on account of the lessened alkalinity of the intestinal contents, it is not decomposed into its constituents, and for that reason becomes very much less effective. In chronic colitis it may be combined with castor oil and administered in wafers. Sometimes it will lessen the glucose-excretion in diabetes mellitus. It has been employed in infections of the urinary tract since phenol sulphonate tends to make the urine antiseptic. Here an alkali should be administered at the same time. Phenyl salicylate has proved efficient in the so-called bilious form of sick headache and in some varieties of neuralgia, and is highly commended in the treatment of **epidemic influenza.**

DIVISION X.—DRUGS ACTING ON THE NERVOUS SYSTEM

A, Drugs acting on the Peripheral Endings of Motor Nerves.—Conium, which is no longer official, is the important drug of this class. While others have a special action on the motor nerve terminations, in most of them this is more or less over-shadowed by other effects. This action, however, is not made use of in medicine.

Drugs paralyzing the termination of the motor nerves in muscle:

(1) **Conium.**
(2) **Belladonna.**
(3) **Stramonium.**
(4) **Hyoscyamus.**
(5) **Scopolamine.**
(6) **Sparteine.**
(7) **Amyl nitrite.**
(8) **Diluted hydrocyanic acid.**
(9) **Cocaine.**
(10) **Camphor.**

Drugs stimulating the termination of motor nerves in muscle:

(1) **Aconite.** | (2) **Pilocarpine.** | (3) **Strychnine** (slightly).

It is possible that some of the beneficial action of strychnine in certain patients may be due to its slight action on motor nerves, but otherwise these drugs are not employed for this purpose.

B. Drugs acting on the Peripheral Endings of Sensory Nerves.—The knowledge of the action of this group is necessarily derived almost entirely from observations on man.

Drugs which Stimulate the Termination of Sensory Nerves.—These are the same as those already enumerated (*see* p. 467) as acting locally on vessels. When topically applied they give rise to pain, and, with most of them, the cause of the pain is the local inflammation they set up.

Therapeutics.—It is for their action on the blood-vessels that local irritants are principally used, but they are not infrequently employed also for their counter-irritant effects. By their application to the skin it is probable that changes are induced in the caliber of the vessels and in the sensory nerves of internal organs, so that deep-seated pain is thereby relieved. The heart and respiration are also reflexly stimulated by peripheral excitation of nerves, and hence counter-irritation is made use of to rouse persons who have fainted or become unconscious from opium poisoning, etc. It is essential that the action should be a prompt one, and the application of the faradic current is quite commonly employed as an external stimulus in such conditions.

Drugs which Depress the Terminations of Sensory Nerves.—Of these there are two kinds: those which simply relieve pain, or **local anodynes**; and those which diminish sensibility, or **local anæsthetics.**

Local Anodynes.—These have no action unless pain be present.

They are—

(1) **Aconite.**		(8) **Diluted hydrocyanic acid.**
(2) **Phenol.**		(9) **Hydrated chloral.**
(3) **Menthol.**		(10) **Belladonna.**
(4) **Veratrine.**		(11) **Stramonium.**
(5) **Ether.**	When allowed to evaporate.	(12) **Hyoscyamus.**
(6) **Alcohol.**		(13) **Scopolamine.**
(7) **Chloroform.**		(14) **Opium.**

The first are the most powerful. The local anodyne action of opium has been disputed, and it is probable that many substances not included in this list which have been regarded as local anodynes have little if any claim to this designation. Cold is an effective local anodyne because of its depressant effect on sensibility, and so likewise is warmth, which relieves pain by diminishing tension, in consequence of the vaso-dilation which it primarily induces.

Therapeutics.—Local anodynes, it may readily be supposed, are called for in a great variety of conditions, and while often of service as adjuvants to internal treatment, they are especially useful in those affections in which it is not possible to remove the cause of the pain or irritation present.

Local Anæsthetics.—These are **cocaine, betaeucaine, phenol,** and **extreme cold,** whether produced by ice or by the evaporation of ethyl chloride, or of ether.

In the performance of operations, the ether spray has the disadvantage of stiffening the parts so that it is only useful for a single incision as for opening furuncles. Upon a damp day it is ineffectual. Ethyl chloride sprayed from tubes by the heat of the hand is the best method and the one most frequently employed at present. Cocaine and betaeucaine, which produce a high degree of local insensibility, are largely employed, generally hypodermatically.

C. Drugs Acting on the Trunks of Nerves.—These, if taken for a considerable period, give rise to chronic neuritis, with much proliferation of the areolar tissue and also fatty degeneration of the nerve-fibers. During the earlier stage of the inflammation marked pain and tingling are experienced, but later these are replaced by numbness and diminished sensation as the function of the nerves becomes more and more depressed, and finally paralysis, often accompanied by trophic lesions, results.

The drugs producing peripheral neuritis are—

(1) Lead.	(3) Arsenic.	(5) Sulphonmethane.
(2) Mercury.	(4) Alcohol.	(6) Sulphonethylmethane.

D. Drugs Acting on the Spinal Cord.—After the administration of certain drugs it is found that a slight peripheral stimulus will produce such marked reflex action that convulsions will result. That this is due to stimulation of the spinal cord, it is determined in the following way: If the cord is cut across and convulsions are still caused by such slight stimulus, it is evident that these cannot be of cerebral origin, since in that instance they would not take place below the point of section. On the other hand, if the drug does not cause convulsions when, previously to its injection into the circulation, the vessels of the cord have been ligated, it is inferred that its action is not on the muscles or nerves. Other experiments going to show that the action is on the cord are the following: If when the drug is injected into vessels by which it reaches the cord quickly, convulsions appear sooner than when it is injected into other vessels; if convulsions do not occur when the cord is destroyed; if when the destruction of the cord is gradually produced by pushing a wire down the vertebral canal, the convulsions cease from above downward as the destruction proceeds.

(1) *Drugs which excite the activity of the anterior cornua are—*

(1) Strychnine.	(3) Chloroform.	(5) Ergot.
(2) Ammonia.	(4) Ether.	(6) Opium.

The last four produce this result only slightly, and early in their action.

Therapeutics.—Strychnine is at times useful for paralysis resulting from diseases of the spinal cord, but with this exception it is rare that affections of the cord are benefited by stimulation of the anterior cornua.

(2) *Drugs which depress the activity of the anterior cornua:*

(1) Physostigmine.	(10) Zinc salts.	(19) Sodium nitrite.
(2) Gelsemium.	(11) Silver salts.	(20) Hydrated chloral.
(3) Bromides.	(12) Sodium salts.	(21) Phenol.
(4) Alcohol.	(13) Potassium salts.	(22) Apomorphine.
(5) Chloroform.	(14) Lithium salts.	(23) Veratrine.
(6) Ether.	(15) Antimony salts.	(24) Turpentine.
(7) Ergot.	(16) Arsenical salts.	(25) Emetine.
(8) Opium.	(17) Camphor.	(26) Colchicum.
(9) Mercury.	(18) Amyl nitrite.	

Of these, apomorphine, alcohol, chloroform, ether, opium, ergot, arsenic, camphor, phenol, hydrated chloral, and veratrine first excite slightly before they depress.

Therapeutics.—So far as their action on the spinal cord is concerned, these drugs are of very little practical utility. Physostigmine, which is by far the most powerful, has been used to some extent in tetanus and other diseases accompanied by convulsions.

E. Drugs Acting on the Brain.—The action of these can by no means be so distinctly localized as that of drugs acting on the spinal cord and nerves. Drugs acting on the brain illustrate: (1) The **law of dissolution,** which, in pharmacology, is as follows: When a drug affects functions progressively, those first affected are the highest in development; that is to say, they are the last acquired by the individual and the last to appear in the species. The next affected are those next to the highest, and so on; until finally the lowest of all from an evolutionary point of view, that is to say, the functions of respiration and circulation, are affected. This law is well exemplified in the instance of alcohol, under the influence of which the first functions to be disordered are those of the intellect, especially the highest, such as judgment and reason; then follow disorders of movement, and finally death from failure of respiration and circulation. (2) When a drug in **moderate** doses **excites** a function, in **large** doses it often **paralyzes** it. Cerebral stimulants may thus also be hypnotics.

Drugs Acting on the Motor Centers of the Brain.—To investigate these, the motor area of the cortex is exposed: (1) Note, before and after the administration of the drug, the strength of the electric current which it is necessary to apply to this area to produce corresponding movements, or, (2) Observe the strength of current necessary to elicit a movement and then allow the wound made by the trephine to close; after which the drug is regularly administered to the animal for several weeks; the opposite motor area is then exposed, and the strength of the current required for the same purpose is noted.

Drugs diminishing the activity of the motor area of the cortex are—

(1) **Alcohol.**
(2) **Anæsthetics.**
(3) **Hydrated chloral.**
(4) **Potassium bromide.**
(5) **Sodium bromide.**
(6) **Ammonium bromide.**

It is on account of this action that bromides are largely employed in epilepsy and other convulsive affections.

Drugs increasing the activity of the motor area of the cortex are—

(1) **Atropine.** | (2) **Strychnine.** | (3) **Physostigmine.**

They are not used in medicine for this purpose.

(1) *General Cerebral Stimulants.*—These produce general excitation of the mental faculties, and this is not infrequently followed by confusion, incoherence and delirium, the character of the latter varying to some extent with the particular drug employed. In many instances the stimulation is soon replaced by a paralyzing influence.

The general cerebral stimulants are—

(1) **Belladonna.**
(2) **Stramonium.**
(3) **Hyoscyamus.**
(4) **Scopolamine.**
(5) **Alcohol.**
(6) **Chloroform.**
(7) **Ether.**
(8) **Caffeine.**
(9) **Guarana.**
(10) **Cocaine.**
(11) **Cannabis.**
(12) **Opium.**
(13) **Camphor.**
(14) **Santonin.**
(15) **Quinine.**
(16) **Salicylic acid.**

Therapeutics.—These are of the greatest importance in their therapeutic applications, and some of them are taken habitually as cerebral stimulants in various parts of the world.

(2) *General Cerebral Depressants.*—These are commonly divided into three classes: Hypnotics, Narcotics and General Anæsthetics.

HYPNOTICS OR SOPORIFICS are drugs which produce sleep, closely resembling, if not identical with, natural sleep. It is known that during sleep the brain is anæmic, and it is probable that the anæmia is the result of depression of the activity of a neurone from retraction of the terminal filaments of the dendrons.

The hypnotics are—

(1) **Opium.**
(2) **Hydrated chloral.**
(3) **Bromides.**
(4) **Sulphonethylmethane.**
(5) **Sulphonmethane.**
(6) **Paraldehyde.**
(7) **Alcohol.**
(8) **Scopolamine.**
(9) **Cannabis.**
(10) **Ethyl carbamate.**
(11) **Lactucarium.**

Therapeutics.—In insomnia the underlying condition should be removed if possible. These drugs should be resorted to with the greatest reluctance on account of the danger of habituation. Hydrated chloral, if used with great caution, paraldehyde, sulphonethylmethane, and sulphonmethane are perhaps the most satisfactory, but the use of hypnotics is apt to be greatly abused. It is well to remem-

ber that sleep may often be induced by causing dilatation of the vessels of parts of the body other than the brain. Thus, a warm bath or a full meal tends to promote sleep.

NARCOTICS are substances which not only produce sleep, but also in large doses depress the functions of respiration and circulation. Many of them fall also under the head of general anæsthetics; others are, in smaller doses, hypnotics.

They are the following:

(1) **General Anæsthetics.**
(2) **Opium.**
(3) **Hydrated chloral.**
(4) **Belladonna.**
(5) **Stramonium.**
(6) **Hyoscyamus.**
(7) **Scopolamine.**
(8) **Alcohol.**
(9) **Cannabis.**

To obtain a narcotic effect these must be given in considerable doses.

Therapeutics.—They are of great value in diminishing morbidly acute perceptions, relieving pain, allaying irritation, nervous excitability and spasm, inducing sleep, and regulating the vital functions by rest. For instance, opium and belladonna are sometimes of much service in cardiac disease.

GENERAL ANÆSTHETICS are drugs which lead to a complete loss of consciousness, so that pain is no longer felt, while at the same time reflex action is abolished. They well illustrate the law of dissolution, and also the fact that, after excitement, paralysis often succeeds. The various stages of their action will be described under Chloroform (*see* p. 773).

There are individual differences in the anæsthetics, and patients are sometimes variously affected by the same anæsthetic.

The general anæsthetics are—

(1) **Chloroform.**
(2) **Ether.**
(3) **Nitrogen monoxide.**
(4) **Many other substitution products,** derived from alcohols and ethers, which are not official.

Therapeutics.—Anæsthetics are given to cause unconsciousness, so that pain may not be experienced during operations, to relax muscles in reduction of dislocations, abdominal examinations, phantom tumors, etc., to relieve severe pain, such as that of parturition, biliary and renal colic, and to control convulsions, as in tetanus and hydrophobia.

The chief dangers of anæsthetics are—1. Death from shock which generally takes place before the patient is fully under the influence of the anæsthetic; reflex action being not yet quite abolished, the heart is stopped reflexly in consequence of the peripheral stimulus of the operation. Such a deplorable result may generally be avoided by taking care that the patient is fully under the influence of the anæsthetic before the operation is begun.

2. Death from paralysis of respiration which may be due to various circumstances. Thus, too much of the anæsthetic may have been given, the patient may be suffering from some disease of the lungs which renders respiration difficult, or the operation may demand a posture which interferes with the breathing. It is not usually a very grave danger, as warning is afforded by the lividity of the surface. Changing the posture and the withdrawal of the anæsthetic are often all that is required to restore the patient, but artificial respiration, with the head thrown back and the tongue pulled forward, may be called for, and in some instances it may be necessary to maintain this for hours.

3. Cardiac failure may occur if the vapor is too concentrated. Gradual heart-failure is always preceded by respiratory changes, but cardiac arrest may occur suddenly and without warning. The patient suddenly grows pale, and the pulse stops. In such an event the anæsthetic should be discontinued, the patient should be placed in the inverted posture, and artificial respiration maintained as before. The heart may be stimulated by large rectal injections of hot normal saline solution or of coffee, if at hand, by the inhalation of amyl nitrite, by the plunging of electric needles into the heart or, better, by making a series of forcible compressions of the chest over the heart; also, if the reflexes are not abolished, by flicking the chest over the heart with hot towels and placing hot compresses over it. Giving brandy subcutaneously is to but add the effect of one poison to that of another. The application of the interrupted current over the cardiac region is also objectionable.

4. Vomited matter or, if the operation is about the mouth, blood, may suffocate the patient. No food should be taken for some time before operation, and if the patient is sick at the stomach, he should be turned on his side. In operations about the mouth special precautions are required.

5. Chilling the patient by exposure during operation which is

favored by the lessened activity of the circulation and dilatation of the cutaneous blood-vessels. This can be obviated by keeping the patient warm by means of heat variously and continuously applied.

F. Drugs Acting on the Eye.

1. DRUGS ACTING ON THE PUPIL.—If when a drug having the property of dilating or contracting the pupil is applied locally to one eye, it acts promptly and powerfully, and only upon the eye into which it is dropped, it is evident that its action must be local. So also when it acts on an excised eye. Again, if the drug will act when applied to the eye after all the vessels going to the eye are ligated, but will not act when thrown into the general circulation, its action is shown to be local. On the other hand, if after being dropped into one eye it acts but feebly and after some time upon both eyes, it is to be inferred that its action is a central one. So, if all the vessels of the eye are ligated, and the drug will not act if dropped in the eye, although it would do so if thrown into the general circulation, it is proved to act centrally. If such a drug acts when locally applied, the inference is that its action is due to the fact that some of it has been absorbed.

As to the manner in which a centrally acting drug exerts its influence, it has been shown that it may act either upon the muscular fibers of the iris, upon the terminations of the third, or motor oculi, nerves in these fibers, or upon the terminations of the cervical sympathetic in them. Stimulation of the third nerve causes the pupil to contract and stimulation of the cervical sympathetic causes it to dilate; while section of these nerves produces just the opposite effects. If, when the pupil is dilated by the local action of a drug, stimulation of the third nerve will not cause contraction, notwithstanding the muscular fibers are responsive to mechanical stimulation, it shows that the terminations of the third nerve are paralyzed. If, on the other hand, the pupil is contracted by the drug, and although responsive to mechanical stimulation, will not dilate after section of the third nerve, it shows that the terminations of this nerve are stimulated. If a drug, locally applied, causes dilatation of the pupil, but not to the same extent as is caused by stimulation of the sympathetic, it is shown that its whole effect is not due to stimulation of the sympathetic; and if the muscle remains locally irritable, there must be paralysis of the terminations of the third

nerve. In a similar way the actions on the sympathetic may be determined. It has been found, however, that many drugs act both on the third nerve and on the sympathetic. These are classified according to their important action.

Mydriatics (dilate the pupil)—

(*a*) *Paralyze the terminations of the third nerve.*

(1) **Atropine.**
(2) **Homatropine.**
(3) **Hyoscyamine.**
(4) **Gelsemium.**
(5) **Hydrocyanic acid.**
(6) **Aconite.**
(7) **Amyl nitrite.**

} probably.

(*b*) *Stimulates the terminations of the sympathetic.*—**Cocaine.**

(*c*) *Act centrally.*—**Anæsthetics** (late in their action).

Myotics (contract the pupil).

(*a*) *Stimulates the terminations of the third nerve.*—**Pilocarpine.**

(*b*) *Stimulates the muscle.*—**Physostigmine.**

(*c*) *Act centrally.*—**Anæsthetics** (early in their action) **and Opium.**

Therapeutics.—Dilators of the pupils, especially atropine and homatropine, are used for ophthalmoscopic examination, and to prevent or break down adhesions of the iris. Contractors of the pupil, especially physostigmine, are used to overcome the effects of atropine, to prevent or break down adhesions of the iris, and to prevent too much light entering the eye in painful diseases of the organ.

2. DRUGS ACTING ON THE CILIARY MUSCLE.—The following drugs impair or paralyze accommodation:

(1) **Atropine.**
(2) **Hyoscyamus.**
(3) **Homatropine.**
(4) **Cocaine.**
(5) **Physostigmine.**
(6) **Pilocarpine.**
(7) **Gelsemium.**

The following actions should be noted: Intra-ocular tension is increased by atropine (large doses) and hyoscyamine. It is decreased by cocaine, scopolamine, and physostigmine. Gelsemine paralyzes the external ocular muscles, especially the levator palpebræ and the external rectus, by its action on the terminal nerve filaments. Cocaine, by stimulating the unstriped muscle fibers in the orbital membrane and the eyelids, causes the eye to protrude. The capacity for seeing blue is increased by strychnine. Santonin causes at first violet, then later yellow vision.

G. Drugs Acting on the Ear.—Very little is known of the action of drugs upon the organ of hearing. Some substances, such as quinine and salicylic acid, cause ringing and buzzing in the ears, and sometimes deafness.

H. Drugs Acting on the Sympathetic System.—The principal facts in regard to the actions of drugs on the sympathetic system have already been considered in discussing their actions upon blood-vessels.

Drugs Acting on the Muscles.—While many facts of interest have been ascertained in regard to this class of drugs, they have no practical bearing on therapeutics.

Veratrine and dried suprarenals increase muscular action, with delayed relaxation, when locally applied, while potassium salts and senegin depress it. Physostigmine increases the excitability. Caffeine increases the capacity for work, even when given internally.

Drugs Acting on the Peripheral Endings of Sensory Nerves

COCAINE

For the Preparations of Cocaine *see* p. 132.

Action of Cocaine

External.—Cocaine has no action on the unbroken skin, but upon mucous membranes or in the subcutaneous tissue it produces **complete local anæsthesia.** At first, owing to the contraction of the vessels caused, the surface to which it is applied becomes somewhat blanched, but later there is hyperæmia with increased redness of the part, in consequence of secondary vascular dilation. A 5 per cent. solution of the hydrochloride will paralyze the sensory nerves, but to produce this effect on motor nerves requires a much stronger dose. The local application of cocaine to the tongue abolishes the sense of taste for bitter, diminishes it for sweet and sour while that for salt is unchanged; and to the nose, that of smell. Anæsthesia results, no matter to what part of the nerve cocaine is applied, whether it reaches it by application to mucous membranes, hypodermatically, direct injection into the nerve trunk or into the spinal canal affecting the sensory roots. It is a **protoplasmic poison,** stopping the motions of leucocytes and amœbæ, and its effects as a local anæsthetic are no doubt attributable to its destructive action on the protoplasm of the organs. Occasionally, when used hypodermatically it may cause necrosis of the skin or a sterile abscess. In addition to the anæsthesia there is local contraction of the arterioles from stimulation of both vaso-constrictor nerve endings and of the muscles.

Internal. *Gastro-intestinal Tract.*—In South America from time immemorial the natives have chewed coca leaves to relieve hunger

and fatigue. On account of its anæsthetic effect on the gastric mucous membrane cocaine deadens the sensation of hunger, and tends to allay irritability of the stomach, but the drug is not an aliment, and if no food is taken, rapid emaciation occurs under its use. In exceptional instances nausea, vomiting and diarrhœa are caused when poisonous quantities are swallowed. According to some, intestinal peristalsis is markedly increased by moderate doses, while after large doses this increase is followed by great sluggishness, deepening into paralysis.

Circulation.—The pulse-rate is lessened by very small doses, in consequence of stimulation of the vagus center, but increased by large doses, which depress the vagus. Usually, but not invariably, the heart is eventually slowed, apparently from a direct depressant action on the cardiac muscle. Cocaine constricts the arterioles, mainly from stimulation of the vaso-constrictor center, and in the earlier stages of the poisoning the vessels are much contracted. This, together with the increased rate of the heart, leads to a marked rise in the blood-pressure which later falls, probably from peripheral action.

Respiration.—The respiratory center in the medulla is at first stimulated and then depressed. Consequently, the respiration is primarily accelerated, but as the depression comes on, the amount of air inspired gradually becomes diminished, and the breathing grows slow, weak and irregular. Cheyne-Stokes respiration is frequently present and death occurs from asphyxia.

Nervous System. Cerebrum.—The first effect is a stimulation of the higher parts of the brain, such as is caused by caffeine. In man, even the local use of the drug may awaken mental symptoms; such are loquacity, mental exhilaration and general self-satisfaction. In animals there is increased movement, which is perfectly coördinated. All observers agree that cocaine has remarkable potency in increasing muscular power from stimulation of the motor areas so there there is restlessness, and fatigue is lessened. If the quantity taken is sufficiently large, the stimulation is followed by depression, which is often first shown in choreic movements, from derangement of the coördinating functions. Narcosis ensues, and this is succeeded by convulsions of cerebral origin. If the paralysis is rapid, it is found that the convulsive stage may be absent, so that collapse occurs without warning.

Medulla Oblongata.—The medulla is early affected, and the various

centers, respiratory, vaso-constrictor, and cardiac accelerator, are first stimulated and then depressed.

Spinal Cord.—The cord, too, is at first stimulated, as is shown by exaggeration of the reflexes and later depression. It will thus be seen that the action of cocaine an the central nervous system consists in a descending stimulation, followed by depression, which successively progresses from the cerebrum to the spinal cord. In some instances, however, it is to be noted, the stage of stimulation is very short or altogether absent, and it has also been observed that the two stages are not definitely divided so that one part of the cerebrum may show depression while another is still excited. With small doses the cerebrum chiefly is affected.

Eye.—Cocaine, applied to the eye, causes local anæsthesia and pallor of the conjunctiva and iris, from vascular constriction. When it is applied to the conjunctiva, in considerable quantity and for some time, and also when it is administered systemically, ocular phenomena are produced which are the same as those caused by **stimulation** of the **cervical sympathetic.** It is therefore considered that cocaine has a special action on the centers or terminations of this nerve, and there is reason to believe that the stimulation to which it gives rise really affects both. **Mydriasis** is caused, although the iris still reacts to light, and the **accommodation** is **unimpaired.** The intraocular tension is not reduced. The dilatation of the pupil differs from that due to atropine as regards the persistence of the reaction to light and in being less complete. The mydriasis is also more readily overcome by pilocarpine than that caused by atropine. Either strong or weak cocaine solutions when frequently applied desiccate the corneal epithelium.

Temperature.—Under large doses of cocaine the temperature rises, and this has been ascribed to a stimulation of the thermogenetic center in the brain.

Excretion.—Cocaine is eliminated in the urine; the quantity appears to be sometimes increased and sometimes diminished. In some instances an injection of the drug has been followed by complete anuria lasting for several hours. In view of the variations noted, it has been suggested that the action is not a direct one on the kidney, but is caused merely through the changes in the caliber of the vessels. The effects on the vaso-motor center, an early stimulation and later paralysis, would account for such variations. The other secretions

seem to be rather diminished than increased. Cocaine has some anaphrodisiac effect.

Therapeutics of Cocaine

External.—A 5 per cent. solution of cocaine hydrochloride may be injected subcutaneously as a **local anæsthetic** for the performance of small operations. In the infiltration method of Schleich, three solutions are employed: cocaine hydrochloride, 0.2 (strong); 0.1 (normal); or 0.01 (weak); morphine hydrochloride, 0.025; sodium chloride, 0.2; sterilized distilled water to 100. These are injected into the substance of the skin, forming wheals. This method requires less of the drug than when it is used subcutaneously. Yet it should be borne in mind that the anæsthetic properties of the two weaker solutions depend largely upon the mechanical anæsthesia produced by injection of water. Solutions of cocaine hydrochloride, topically applied, are used for operations on the mouth, throat, teeth (4 per cent.), eye (1 to 4 per cent.), ear, vagina, urethra and rectum (4 to 10 per cent.). In the nose, it is also employed to check bleeding and to relieve the hyperæmia of rhinitis. In the throat it may relieve an annoying cough or the pain of tuberculous laryngitis. Congestive urethral stricture may be temporarily relieved by it, so that instruments may be passed, but it should be employed with great care in urethral operations. It is used on mucous membranes for the relief of pain in various conditions, and also for the abatement of inflammation. It is of service in painful ulcers and fissures of the anus, and in pruritus of the vulva and anus, and is also used as an application to to the nasal passages in coryza and hay fever. Ophthalmic surgeons employ it very largely to produce local anæsthesia of the eye. If inflammation is present, however, anæsthesia is produced with great difficulty.

Internal.—Cocaine, because of its effect in depressing the gastric sensory nerves, is sometimes employed to **relieve vomiting** in pregnancy, seasickness and other conditions. It may be given in solution in an appropriate vehicle as a stimulant in low fevers, and in instances where great physical and mental strain is to be borne. The preparations of coca, especially the wine, none of which are official, are much used as stomachic tonics, and in the debility of convalescence from acute diseases.

Spinal Anæsthesia.—Within the last few years it has been pro-

[illegible] of solutions [illegible] disease or [illegible] may also be [illegible] the lower extremities. Puncture is made [illegible] between the spinous processes. A few drops of a solution of cocaine [illegible] anesthesia supervenes [illegible] the chest or [illegible] the physician; the [illegible] for the period [illegible] The action of anesthesia does not [illegible] pain. The patient [illegible] observation, but without [illegible] vomiting and nervous [illegible] headache, after-effects [illegible] from collapse, however, [illegible] the puncture: so that it seems [illegible] ether or chloroform narcosis, or [illegible] without [illegible] risk except when complicating [illegible] either of these anesthetics.

POISONING

Acute poisoning. Symptoms.—These have followed the injection of cocaine [illegible] during operations or an operation, and may sometimes occur from the introduction of the drug under the gums or skin. Otherwise it is not often met with. The symptoms vary in different individuals, but usually the patient at first [illegible] more or less excited, restless and garrulous. The pulse and respiration [illegible] the pupils dilated, and there are present dryness of the throat, [illegible], vertigo and confusion. There may be exaggeration of the reflexes, [illegible] and slight convulsive movements are apt to occur. Later, powerful [illegible] of clonic convulsions may come on. The heart becomes turbulent in its [illegible], and the respiration, which soon grows dyspnoeic in character, may be arrested during a convulsion. In other patients no actual convulsions may be met with, while fainting and unexpected collapse supervene. The patient suffers from profound cardiac and respiratory depression, with tremors, and the skin is cold, cyanotic and clammy. Death may take place from gradual failure of the respiration, and if the patient survives he may suffer for months from tremors and other nervous symptoms.

Treatment.—If the drug has been taken by the mouth the stomach should first be evacuated by washing out or by the use of apomorphine. The treatment

is mainly one of stimulation, and strychnine is especially indicated as a respiratory stimulant. Artificial respiration may also be called for. Amyl nitrite may be of service if the blood-pressure is high, and small quantities of chloroform or ether, by inhalation, may be required for the convulsive attacks.

Chronic poisoning, or Cocamania, is not infrequently seen from taking the drug as a snuff, rubbing it into the gums, swallowing it or using it hypodermatically although its detection is often difficult. The victim of the habit generally loses flesh and sometimes suffers from fainting. Among the phenomena characterizing the condition are disorders of the circulatory system, febrile attacks without apparent or adequate cause, insomnia, mental failure, and delusions not unlike those of chronic alcoholism. Visual and other hallucinations, generally of a disagreeable type, are often present, and one symptom which is regarded as pathognomonic of subacute or chronic intoxication with this drug is a sensation of crawling worms or insects ("cocaine bugs") under or on the skin. Sometimes there is delirium or acute mania. The central nervous system seems to undergo degeneration like that observed in chronic morphine poisoning. The moral degradation is fully equal to that of opium-eaters; most are inveterate liars. Cocaine is usually taken by hypodermatic injection, is often employed in association with morphine, and the habit is sometimes acquired by those making use of this drug to break themselves of the morphine habit.

The habit is difficult to cure, as relapses are frequent. The most important point in the treatment is the withdrawal of the drug, though the sudden stopping of it may bring on profound collapse. There is little chance of a successful result unless the patient is confined for a considerable time in sanitarium, where access to the drug is impossible.

BETAEUCAINE HYDROCHLORIDE

For the Preparation of Betaeucaine Hydrochloride *see* p. 112.

Action of Betaeucaine Hydrochloride

Injected hypodermatically in solutions of about the same strength as those of cocaine it causes local anæsthesia of the same intensity and duration. It is less irritating and does not affect the heart; if used in the eye does not produce marked mydriasis, corneal lesions nor disturbances of accomodation. It can be sterilized without deterioration.

Therapeutics of Betaeucaine Hydrochloride

Its field of usefulness is the same as that of cocaine; for various operations where local anæsthesia, either hypodermatically or by the infiltration method, is applicable. For intraspinal anæsthesia, while the after-effects are no greater than with cocaine, the anal-

gesia is not so uniform nor lasting. That it is comparatively less toxic than cocaine, and the certainty of sterilization of its solutions by boiling make the remedy preferable for practical use.

ETHYL CHLORIDE

For the Preparations of Ethyl Chloride *see* p. 100.

Action and Therapeutics of Ethyl Chloride

Ethyl chloride produces general anesthesia but often without muscular relaxation. The pulse is slow and the respiration is deep. It produces intense cold by its evaporation.

It is used principally for the production of local anæsthesia and to relieve the pain of neuralgia, etc. It is supplied in glass tubes having a pointed extremity, and, when the end is broken off and the tube held in the hand, it escapes in a fine stream which is directed upon the part it is desired to affect. The skin should first be cleansed of all fat by the use of soap, followed by washing with ether. The freezing of the tissues sometimes results in sloughing or difficult healing.

Internally ethyl chloride has been used as a general anæsthetic, for short operations and as an anæsthetic preliminary to ether or chloroform in longer operations. It acts very promptly, and is preferably employed with a special inhaler, into which it can be vaporized. It is about as safe as chloroform, but for major operations, the rapidity with which consciousness returns and the difficulty of maintaining uniform anæsthesia, has led to its disuse.

Drugs Acting on the Spinal Cord

1. Drugs which excite the anterior cornua.

NUX VOMICA

For the Preparations of Nux Vomica *see* p. 128.

Action of Nux Vomica

External.—Strychnine is a very powerful **antiseptic,** and when injected subcutaneously in concentrated solution, is irritating to the tissues.

Internal.—*Gastro-intestinal Tract.*—Nux vomica is a **bitter,** increasing the appetite and aiding the digestion. In the intestine it is directly stimulating to the muscular coat of the bowel. Hence it **promotes peristalsis** and has a purgative action. Strychnine is rapidly absorbed, mainly from the intestines.

Circulation.—Strychnine, by stimulating the vaso-motor center, produces **constriction** of the **arterioles,** thereby causing a **rise of blood-pressure,** which is augmented by the increased peripheral resistance arising from the general activity of the muscles. The result is that the force of the heart is increased and the diastole lengthened. The pulse is also slowed by the stimulation of the vagus center in the medulla. The direct action on the heart is probably less marked than has been generally supposed. During the convulsions caused by the alkaloid the blood-pressure is raised to an extreme height, partly by the action on the vaso-motor center and partly, it may be, in consequence of the blood being pressed out of the abdominal organs and the muscles by their violent contraction. Immediately after a convulsion the blood-pressure falls. The vascular constriction, it would seem, affects chiefly the internal vessels, while, as a result probably of stimulation of vaso-dilator areas in the medulla, those of the skin and possibly of the muscles are dilated; consequently there is an afflux of blood to the extremities and cutaneous surface. The heart is found to beat long after the respiration has failed, and if artificial respiration be maintained, may continue to do so for an indefinite period.

Respiration.—The **respiratory center** in the medulla is **stimulated** directly and also reflexly by reason of the increased muscular activity. The respiratory movements are consequently **accelerated and strengthened.** As the muscles of respiration participate in the general convulsive seizure, however, they ultimately become completely exhausted, and death by asphyxia may occur suddenly after a spasm. In other instances the fatal result is due to gradual paralysis of the respiratory center. Between the convulsions the breathing is usually fairly regular, but during their presence it is arrested by the violent contraction of the diaphragm and the other respiratory muscles.

Nervous System and Muscles.—The cerebrum is believed to be slightly stimulated as to mental processes, although to a less extent than the lower divisions of the central axis. The intellect and consciousness remain unaffected, but the **special senses** are rendered **more acute,** and the irritability of the motor parts of the cortex is distinctly increased, except during a convulsion. In the medulla oblongata there is produced an active **stimulation, followed by paralysis,** of the respiratory, vaso-motor and vagus centers. While the stimulation of the vagus causes slowing of the pulse, this effect is more or less off-

set by the influence of the convulsions, since great muscular activity always tends to accelerate the heart. The clinical evidence is in favor of the cardiac center being strongly influenced. Strychnine in small amounts increases the tone of the medulla, augmenting the impulses which the medullary centers are constantly receiving. Consequently, the increased activity of the higher reflex areas may diminish or inhibit the irritability of the cord, so that the reflex response from the latter may be rendered more marked by the removal of the cerebrum and medulla oblongata. The most marked effect of toxic amounts of strychnine is an **increased reflex irritability** of the **spinal cord,** which is shown most conspicuously by the production of **tetanus.** After a short period of augmented reflex excitability, severe spasms of **spinal origin** occur, in which there are sudden and violent contractions of all the muscles of the body, the stronger flexor muscles generally prevailing against the extensors. In the intervals, lasting only a few minutes, between the convulsions there is completed relaxation. The **conduction power** of the **cord** is **enormously exaggerated** by strychnine, since general convulsions follow upon a peripheral stimulation so slight as to be even imperceptible. The exact location of the action of strychnine in the spinal cord has not as yet been determined. In the present state of our knowledge it may be said that the drug removes resistances which normally oppose the passage of impulses somewhere between the point at which the centripetal fibers enter the cord and the motor cells, but does not apparently act upon the motor cells of the anterior horn, nor, indeed, upon the posterior root ganglion. It is consequently regarded as most probable that it affects chiefly some cells intercalated between these structures. Strychnine does not seem to have any direct action on the voluntary muscles. While very small quantities have the effect of increasing their tone, this is attributable to action on the spinal cord and not on the muscle fibers. Neither muscles nor afferent nerves are directly affected by the largest doses of the poison.

Special Senses.—The influence of strychnine in small doses in increasing the acuteness of the special senses, is believed to be probably a cerebral action, although it may be due to alterations in the peripheral organs. While the acuteness of the hearing and the sense of smell is apparently increased, the effect of the drug is most decidedly shown in the sense of touch, the delicacy of which is markedly augmented, and in the vision. The field of the latter is enlarged, espe-

cially for blue, and differences can be recognized between shades of color which ordinarily seem identical; while in certain conditions of amblyopia, light is said to be rendered much more distinct.

Metabolism.—In consequence of the increased contractions of the muscles throughout the body, there is naturally an increased oxidation, and the amount of oxygen absorbed and of carbon dioxide excreted by the lungs shows a corresponding augmentation. This increased excretion of carbon dioxide is due in part to the contraction of the muscular coats of the blood-vessels and possibly to the increased metabolism in the central nervous system. There is an increased production of heat in consequence of the increased oxidation of the tissues, but is offset, to a varying degree, by an augmented skin dissipation. While, however, the internal temperature may be even slightly lower than normal, the cutaneous temperature generally shows a considerable rise on account of the afflux of blood to the surface.

Elimination.—Strychnine, which is rapidly absorbed, is excreted in part unchanged, principally in the urine, but also in the saliva, sweat and bile. The excretion, although it commences promptly, and most of the strychnine is eliminated within twelve hours, is very prolonged, usually continuing for a week or more. Part of the strychnine is destroyed, probably through oxidation, in the tissues, and some may be retained for a long time in the liver and central nervous system.

Therapeutics of Nux Vomica

External.—On account of its very pronounced toxic character, strychnine is never employed for antiseptic purposes.

Internal. *Gastro-intestinal Tract.*—Tincture of nux vomica is an admirable **stomachic bitter,** and is especially useful in patients where impairment of digestion is due to enfeeblement of the general system. Nux vomica may often be combined with diluted hydrochloric acid and a bitter, as gentian or cinchona. In the gastric catarrh and morning vomiting of drunkards it is considered as next in value to arsenic. It may be given advantageously with mineral acids. In constipation in which the contractile power of the muscular coat of the intestine is feeble, it is of great service in promoting peristalsis. In instances of this kind it is commonly associated with remedies appropriate to the special condition, as for instance, with preparations of

iron for patients suffering from anæmia. The drug has been advised in a variety of indefinite conditions of depression, in which it is difficult to say whether the results are to be ascribed to its effect in improving the appetite and digestion or in increasing the activity of the spinal cord and medulla.

Circulation.—Nux vomica and strychnine are useful as **cardiac stimulants,** especially in instances of disease of the heart in which digitalis is contra-indicated. They are sometimes combined with other cardiac stimulants, such as caffeine. In instances of urgent danger from failure of the heart's action in the course of chronic cardiac disease and other affections the prompt use of strychnine by hypodermatic injection not infrequently proves of the greatest service.

Respiration.—Strychnine is an excellent **respiratory stimulant.** It may be given with expectorants when there is an abundant mucous secretion and little effort is made for its expulsion, but is contra-indicated in dry constant cough with scanty expectoration. It is especially valuable when in bronchitis the respiration has become weak and shallow. In pneumonia it is extremely useful when death is imminent from dilatation of the right heart, administered hypodermatically and at frequent intervals. In many instances of poisoning also, especially by agents tending to cause failure of the respiration, its employment in judicious doses by this method serves a useful purpose on account of its pronounced stimulating action upon the respiratory center in the medulla.

Nervous System.—In nervous diseases strychnine has been used often without proper discrimination, consequently, the results obtained have not always been of a satisfactory character. On account of its action on the central nervous system, it is prescribed in different forms of **paralysis,** and some restitution of function, or, it may be, some retardation of the disease, may attend its use in many of them. It is found that the patients in whom it is of the most benefit are those in whom there is present no well-marked central anatomical lesion, as in hysterical, neurasthenic, diphtheritic and syphilitic paralyses, and in paralysis due to such poisons as lead and arsenic. Little is to be expected from it when sclerosis exists, and in paralysis resulting from cerebral apoplexy it may possibly prove injurious in consequence of the congestion of the brain and tendency to recurrence of the hæmorrhage caused by its action in increasing the blood-pressure. It may,

however, be sometimes given with advantage in hemiplegia when sufficient time has elapsed to permit repair of the damage done by the extravasation and is of most service when the paralyzed members are completely relaxed. The most important use of strychnine in these instances is to open the normal paths of conduction when they have become obstructed so that a normal afferent impulse can influence the motor cells, thus increasing the tone of the muscles. When the paralysis has existed so long that the muscles have undergone degeneration it is quite useless. Strychnine is always contraindicated in paralytic patients when headache, vertigo and tinnitus aurium are present. It sometimes proves useful in the nocturnal enuresis of children, as well as of incontinence of urine in adults, and this has been attributed to the increased tone of the sphincters resulting from augmented excitability of the spinal cord. On account of its action on the cord, it has also been used as an emmenagogue and as an aphrodisiac in impotence.

TOXICOLOGY

Symptoms.—The time of the appearance of the symptoms will depend largely upon individual differences and upon the manner of introduction. If the poison is taken by the mouth, the promptness of its action will be affected by the condition of the stomach, whether empty or full, and by the nature of the food, if any is present. If subcutaneous injection has been employed, the time will be dependent somewhat on the place of introduction. Strychnine will act more rapidly than tincture of nux vomica, and both of these more quickly than a pill. The symptoms do not often develop in less than fifteen minutes, and are not generally delayed beyond half an hour, but have been known not to appear for nearly two hours. If the dose is within therapeutic limits and yet sufficient to produce an untoward effect, the first symptom is likely to be a feeling of uneasiness with a heightened reflex irritability, and this may be followed by muscular twitching in some part of the body. When a large dose has been taken, with or without a preliminary sense of impending suffocation, convulsive movements begin, which have the effect mechanically of causing the patient to cry out or shriek, and they are very quickly followed by the characteristic spasms, which now set in with great violence. These are at first clonic and then tonic. Opisthotonos results from the extensor muscles overcoming the flexors, and the feet are curved inward. The spasms then again become clonic, and soon an intermission ensues. Suddenly the convulsions commence again, and there is thus an alternation of the convulsive attacks and remissions. During the latter there is complete muscular relaxation and general depression in place of stimulation. With each successive attack the symptoms increase in violence. The patient often rests on his head and feet, the remainder of his body being arched above the bed or floor. The face becomes livid and the eyeballs staring, while the chest and abdomen are

stiff as a board. The contractions of the facial muscles occasion *risus sardonicus*, the patient grinning in a ghastly manner, but those of the jaw are not affected till towards the last. This aids in distinguishing strychnine poisoning from tetanus, in which the muscles of the jaw are implicated very early. Other diagnostic marks of tetanus, as contrasted with it, are the slower development of the symptoms and the continuous muscular rigidity; for while between the paroxysmal exacerbations there is some diminution of this, there is never complete relaxation, as in strychnine poisoning. In strychnine poisoning, the pulse is very rapid, and the sight, hearing and sense of touch become abnormally acute. The patient is entirely conscious, and usually suffers excruciating pain, though in exceptional instances the asphyxia produces more or less anæsthetic effect. The interference with circulation and the pressure on the abdominal viscera, aided by the stimulation of the medullary centers, may give rise to vomiting and purging. The respiration during the attack is at first labored and dyspnœic, and then is temporarily arrested by the spasmodic contraction of the diaphragm. Foaming at the mouth may occur in consequence of the interference with respiration, and the asphyxia resulting from the latter induces cyanosis, dilatation of the pupils, and eventually coma. In the intermission the patient lies exhausted, and covered with a cold sweat. The slightest noise or touch, or even a bright light, is likely to bring on a convulsive seizure, which may throw the patient out of bed. The number of seizures varies in different instances, but three or four are usually fatal; the patient succumbing to asphyxia and exhaustion. The smallest dose of strychnine known to have proved lethal is 0.03 gm. (½ gr.). *Post-mortem.*—As in other conditions characterized by violent convulsions, there is early and often persistent rigor mortis. The appearances are those due to asphyxia and the convulsions: venous engorgement of the internal organs and, generally, hyperæmia of the central nervous system, with small hæmorrhages. Quite rarely there is also hyperæmia of the mucous membrane of the gastro-intestinal tract.

Treatment.—Give emetics (p. 380), particularly apomorphine hydrochloride hypodermatically, or wash out the stomach if the patient is seen early enough for the passing of the tube not to cause spasm. Lavage may be practised with solution of potassium permanganate, as in instances of opium poisoning, but it is not so effective here. If very violent convulsions are already present, evacuation of the stomach, as a rule, should be avoided, as either emetics or the stomach-pump will have the effect of starting the spasms. Although catheterization of the bladder is indicated in order to prevent the excreted strychnine from being reabsorbed, even this procedure may excite convulsions. Intravenous saline infusions will aid in the elimination of strychnine by way of the kidney as will also high colonic irrigations with hot normal salt solution; neither method may be possible to be carried out. Both potassium permanganate and iodine are chemical antidotes, and when one of these is employed, it is not so necessary to empty the stomach. When a fatal dose has been taken, however, the chances are that neither evacuation nor any chemical antidote will be of service, for by the time the physician can arrive, sufficient of the poison will probably have been absorbed to render both useless. Chloroform is the best physiological and most practical antidote, and it has the special advantage that its action can be very largely controlled. Hydrated chloral may be useful, and is often advised, but is open

to the objection that with it there is always the risk that its paralytic effects may coincide with those of the strychnine, and thus increase the patient's danger. Both hydrated chloral and morphine are antidotal to strychnine as regards the effect on the cerebrum, but this is of little importance, because morphine may only add to the gravity of the symptoms by increasing the reflex excitability of the spinal cord and by its depressing effect on the respiration. Owing to the fact that paraldehyde does not depress the respiratory center, it may be of use in some instances for it is failure of this center that is always imminent. Although physostigma and gelsemium are theoretically more perfect physiological antagonists, since both depress the anterior cornua, they are practically of very little value in strychnine poisoning. Other measures which have been recommended are the administration, for prolonged effect, of large doses of potassium bromide *per rectum* and the use of amyl nitrite inhalations. If the patient is seen early, the employment of tannic acid in large quantities may be of service, as the insoluble tannate is formed in the stomach. This should be gotten rid of, however, as soon as possible, as it becomes broken up by the action of the gastric juice, and the strychnine is then rapidly absorbed. Artificial respiration, as well as the inhalation of oxygen, which not only replaces natural respiration but increases the rapidity of the oxygenation of strychnine in the body, should usually be commenced early.

2. Drugs which depress the anterior cornua.

PHYSOSTIGMA

For the Preparations of Physostigma *see* p. 130.

Action of Physostigma

External.—A strong solution of the alkaloid physostigmine is said to have the effect of slightly diminishing the functional activity of motor and sensory nerves, while, applied to the conjunctiva, it causes contraction of the pupil, myopia, and dimness of vision.

Internal. *Alimentary Tract.*—Physostigmine has the effect of **increasing** the **secretions** of the glands, especially the salivary, mucous, lachrymal, sweat, and pancreatic, and this is due to its stimulating action on the terminations of the secretory nerves in the gland-cells. It thus acts on the same point as atropine, but in an exactly opposite manner. After the drug has been absorbed, therefore, there is usually an augmented flow of saliva, but the secretion may be inhibited or soon checked by the contraction of the arterioles caused, and the consequent insufficient nutrition of the gland cells. In the stomach and intestine it induces a marked **increase in peristalsis,** in consequence, it is believed, of its action on the nerve endings in the muscular coats of these viscera, and consequently, if the dose

is not too small, vomiting and purging are caused. The powerful contractions to which it gives rise are of the same general character as those produced by pilocarpine, but it is found to differ from them in causing these movements after small quantities of atropine, while larger doses of atropine again stop the contractions set up by physostigmine. The peristaltic movements culminate in a **tetanic contraction** of the muscular walls, which prevents the passage onward of the contents of the viscera.

Unstriped Muscle.—On unstriped muscle in many parts of the body physostigmine has the same action as in the gastro-intestinal tract. It thus probably induces contraction not only of the iris, but of the bronchial tubes, spleen, uterus, ureters, and the gall and urinary bladders. It is also said by some to affect the arterioles in the same way, and it is probable that it causes contraction of their muscular coats by stimulating the vaso-motor terminations in them.

Circulation.—In consequence of the violent contractions of the stomach and intestine, which expel the blood from a very large area, and also in part, it is supposed, of a stimulation of the vaso-motor center in the medulla, there is a considerable **rise** in the **blood-pressure.** The pulse is **slowed** by physostigmine, and this is believed to be due to its direct action on the heart muscle rather than to any inhibitory interference, since slowing occurs even after large amounts of atropine. The amplitude of the cardiac movements, whether due to a strengthening of the contractions or to the slow rhythm, is afterwards diminished. The rise in blood-pressure is also succeeded by a fall, and this is ascribed to paralysis of the vaso-motor center. If large quantities of the alkaloid are injected, there is an immediate fall in the blood pressure, and this is accompanied by a further slowing of the pulse.

Respiration.—The respiration, which is at first quickened and strengthened, soon becomes retarded and dyspnœic, and death, which is due to paralysis of the respiratory center, takes place from **asphyxia.** The primary acceleration may be due in part to stimulation of the sensory terminations in the lungs and partly to central stimulation. The subsequent dyspnœa is no doubt owing in some measure to spasm of the bronchial muscles, as well as to depression of the respiratory center in the medulla.

Nervous System.—It is not known positively whether or not any general stimulation of the central nervous system is caused by physo-

stigmine, but the primary quickening of the respiration, as well as the changes in the blood-pressure, points strongly towards this. As regards the cortex, it is still undetermined whether the collapse met with in severe poisoning is preceded by a stage of slight stimulation. There is no question but that the drug causes **central depression.** Whether this begins in the spinal cord and medulla, and only spreads to the cerebrum after large doses, is unknown, and some hold that the higher centers are depressed earlier than the lower ones. However, consciousness remains unimpaired after the respiration and muscular power have become seriously affected; indicating that some of the higher cerebral areas preserve their functions after others have been weakened. In the medulla, as has been mentioned, the respiratory and vaso-motor centers eventually become paralyzed. **Reflex activity** is **inhibited** in consequence of **depression** of the **anterior cornua** of the spinal cord, as may be seen when physostigmine is applied directly to the cord. At first such activity is slightly increased, but this is the result of irritation, such as may be caused by almost any substance, and there soon succeeds a total abolition of reflex excitability. Subsequently there is paralysis of the posterior portion of the cord also, with diminution of cutaneous sensibility.

Muscles and Nerves.—**Muscular twitchings** are caused by large amounts of physostigmine, and constitute one of the most characteristic features of the poisoning. In some instances they are so pronounced as to simulate convulsions, but are distinguished from the latter in not involving the whole of a muscle at one time. This phenomenon is probably attributable to the action on the motor nerve terminations, though some believe that it is due to direct action on the muscle.

Eye.—Although the application of a solution of physostigmine to the conjunctiva always causes the **pupil** to **contract** to its smallest diameter, this effect is not invariably, but generally, observed in systemic poisoning. Such a variation points to its being due to changes in the local mechanism, and there is every reason to suppose that it is caused by a stimulation of the ends of the motor fibers in the third nerve. By its effect on the motor nerve terminations in the ciliary muscle it causes **spasm** of **accomodation,** in addition to the contraction of the pupil from its influence on the iris, and in consequence of the myosis there results a **diminution of intra-ocular pressure.** Associated with these phenomena, especially when they

are decidedly pronounced, there is apt to occur some twitching of the lids, dimness of vision, and supra-orbital pain.

Excretion.—Physostigmine is readily absorbed and is eliminated rapidly, chiefly in the urine, though traces of it have been found in the bile and saliva. The action of the alkaloid is much more constant, than that of physostigma itself, and this may be because the effects of the other active principles in the crude drug interfere to some extent with those of the physostigmine.

Therapeutics of Physostigma

Unstriped Muscle.—Physostigma has been used to a limited extent in affections in which its property of stimulating involuntary muscle may be availed of. It has a certain value in atony of the bladder and intestines and in catarrh of the bowels, and is given in purgative pills to stimulate the muscular layer of the intestine. Combined with nux vomica, it has been employed with advantage in gastric and intestinal dilatation. It has been especially recommended for the troublesome flatulence of women at the time of the menopause, which is ordinarily associated with a paretic state of the muscular coat of the bowel, and with the relief afforded to the flatulence there usually comes relief to the headache, vertigo and morbid fancies so often attending it. In chronic bronchitis with deficient power of expectoration, bronchial asthma, and emphysema it may be of service in promoting the expulsion of mucus by its influence over the muscular fibers in the bronchial tubes.

Central Nervous System.—Physostigma has been quite largely employed in the treatment of tetanus; about one-half the patients in whom it has been used are said to have been cured, and it is possible that this proportion might have been larger if sufficient attention had been paid to the quality of the drug employed and to the mode of administration. It has been advised always to commence the treatment by a subcutaneous injection of physostigmine sulphate, in doses of 0.002 gm. ($\frac{1}{32}$ gr.), and frequently repeated, the condition of the patient in the meanwhile being watched with great care, until the system is decidedly affected; then to administer the remedy by the mouth in doses three times as large as those employed hypodermatically. Physostigmine has been given as an antidote for strychnine poisoning (*see* p. 701).

Eye.—A solution of physostigmine salicylate (1 or 2, to water, 480) is dropped in the eye to **break up adhesions** of the iris, to diminish intra-ocular tension, and to prevent prolapse of the iris after wounds, or ulcers of the cornea. It is also employed in glaucoma, to **lessen intra-ocular tension,** in paralysis of the iris and ciliary muscles, and to prevent the entrace of light into the eye in photophobia. It is useful when for any reason it is desired to rapidly overcome atropine mydriasis, but as it is less powerful than atropine, a larger amount will be required for this purpose than was required of atropine to produce the contraction of the pupil.

ANTAGONISM

It will be observed that in its action on the pupil and on involuntary muscle generally, on secretion, on the heart, and on respiration, physostigmine is antagonistic to atropine. In its action on the spinal cord and respiratory center it is antagonistic to strychnine.

GELSEMIUM

For the Preparations of Gelsemium *see* p. 131.

Action of Gelsemium

External.—If a solution of gelsemium or either of its alkaloids is dropped into the eye, it causes momentary smarting and hyperæmia of the conjunctiva together with rapid **dilatation** of the **pupil** and paralysis of accommodation.

Internal.—The action of gelsemium is essentially the same as that of gelseminine, which is the more powerful of its two alkaloids, neither of which are official. It usually has no effect on the alimentary tract.

Circulation.—Almost the only effect it has upon the circulation is to induce paralysis of the inhibitory mechanism of the heart. Very little change is observed in the blood-pressure, even after large amounts, if artificial, is maintained after the failure of the natural, respiration.

Respiration.—Gelsemium powerfully **depresses** the **respiration,** and when taken in toxic doses causes death by asphyxia. The failure of the respiration is probably due to paralysis of the respiratory center, though it seems likely that partial paralysis of the nerve endings in the respiratory muscles may be a contributory cause.

Before death the temperature falls, and the skin is covered with a cold sweat.

Nervous System and Muscles.—The action of gelseminine in general has a distinct depressant action on the central nervous system. The respiratory center in the medulla oblongata, as has been mentioned, is apparently paralyzed. The higher cerebral functions and the sense of pain remain unimpaired until just before death. Gelseminine in poisonous amounts causes loss of coördinating power and extreme **muscular weakness,** with **marked tremor** when any movement is attempted. It is stated that the contractions of the heart are unaffected by stimulation of the vagus, apparently because the ganglionic connections along the course of the inhibitory fibers are paralyzed by gelseminine, while, on the other hand, the terminations of the inhibitory fibers in the cardiac muscle seem to retain their function.

Eye.—The effects of the local application of gelsemium have already been referred to. The **mydriasis** is less complete and less persistent than that occasioned by atropine, but is thought to be due to the same cause, paralysis of the terminations of the motor oculi nerve; there is also loss of power of accommodation. In general poisoning by it marked dilatation of the pupil does not occur until quite late. Disturbance of vision, followed by **diplopia** and **ptosis** is not infrequently observed after gelsemium, and these effects have been attributed to **paralysis** of the **ocular muscles.**

Therapeutics of Gelsemium

It is often successfully used for **migraine,** though how it acts is quite uncertain. Gelsemium seems to be especially efficacious in refractory **neuralgia** of the facial branches of the **trigeminus,** although its method of action is not quite apparent. It is occasionally used locally to dilate the pupil and paralyze accommodation, and it has the advantage that its influence passes off rapidly. The tincture has been used in Ménière's disease and to arrest attacks of colic, in doses of 0.30 mil (5 ♏) every quarter of an hour, which is in excess of the pharmacopœial dose. Gelsemium has sometimes proved of service in torticollis, spasmodic dysmenorrhœa, laryngismus stridulus and whooping-cough, and as an **antispasmodic** in asthma and coughs in general.

THE BROMIDES

For the Preparations of the Bromides *see* p. 34.

Action of the Bromides

External. Potassium, and the other bromides, although they have no effect upon the unbroken skin, yet locally applied in solution, are slightly sedative to mucous membranes, lessening the reflex excitability, especially of the pharynx.

Internal. *Alimentary Canal.*—Bromine closely resembles chlorine in its effects on the system. Administered in concentrated solution, the bromides induce salivation and thirst, and if the amount is large, gastric irritation with nausea and vomiting. Occasionally diarrhœa is caused by concentrated solutions reaching the intestine. These irritating effects are probably due for the most part to the withdrawal of fluid from the mucous membranes, and are not observed when the bromides are given in dilute solution. It has also been pointed out that bromides may disorder the stomach by so decreasing reflex action that the proper secretion of gastric juice and the digestive processes do not take place with sufficient rapidity, and that for similar reasons they may cause constipation. They are rapidly absorbed from the stomach and intestines.

Nervous System.—They have a direct effect upon the central nervous system, excepting the medulla; that of the potassium salt being most marked because with it the bromide action is supplemented by the depressant action of the base. The action consists in a **depression** rather than an abolition of function. The bromides diminish mental activity in general, but this is affected in some respects more than others. Thus, the perception is but little impaired, while the appreciation apparently becomes decidedly defective, so that while stimuli reach the brain much as usual, they do not seem to be adequately apprehended. External objects are perceived, but arouse no interest in the patient, and frequently this state of apathy passes into **drowsiness** and **sleep.** The sleep, however, is never very deep and is not refreshing, while for several hours after waking the patient is apt to be more or less affected with mental confusion. Before slumber comes on there are observed fatigue, lassitude, disinclination for exertion, and often muscular weakness. There is also a marked **diminution in reflex activity.** Thus, the irritation of the mucous membranes of the genito-urinary tract is less liable to set up reflex

movements, tickling of the fauces does not induce nausea, and after very large doses the conjunctiva may sometimes be touched without causing winking. In some instances the general cutaneous sensibility is also diminished, and after large doses there may be more or less complete anæsthesia, which extends to the skin. In addition to the ordinary reflexes, some special functions, as the respiration and the sexual instinct, are depressed. The depression of the spinal reflexes caused by the bromides renders them antagonistic to strychnine, so that in bromidized animals this alkaloid induces convulsions only when given in much larger amounts than is ordinarily required. A stimulation of the motor areas of the cerebral cortex which ordinarily gives rise to general epileptiform convulsions, will, after the administration of bromide, be confined to the area directly stimulated. It would appear, therefore, that the whole cerebrum, excepting the medulla as well as the spinal cord, is powerfully depressed by the bromides. The depression, beginning with the higher functions of the brain, takes place in regular order from above downwards, in the reverse order of the physiological development of the functions; the action, as in the fact with many other drugs, following out the Law of Dissolution (*see* p. 682).

Circulation.—Large doses of potassium bromide have a depressant action on the heart, an effect which is due to the potassium-ion. Sodium bromide has little depressing influence, while the ammonium salt is slightly stimulating to the heart. After administration of the bromides there is often found a contraction of the blood-vessels of the pia mater, and this condition has been supposed to produce cardiac depression, but it seems probable that this anæmia of the brain is analogous to that observed in sleep, and is a result, rather than the cause, of the depression.

Respiration.—The respiration is more or less depressed by large doses. Under toxic amounts the breathing grows progressively slower and shallower, probably from depression of the respiratory center, and by diminishing the tone of the respiratory muscles.

Sexual Organs.—Bromides have a distinct **anaphrodisiac** influence. Whether the depression of the sexual instinct which has been mentioned is due to the action on the cerebral cortex or on the spinal cord has not been determined. A failure of sexual desire and vigor almost invariably results from the long-continued administration of the bromides.

Metabolism.—Under large doses there is a marked diminution in the amount of carbon dioxide exhaled. The quantity of urine is increased, particularly after the use of the lithium salt. The nitrogenous metabolism is not apparently affected, but the sulphur in the urine is increased, while quite commonly the phosphates are materially reduced.

Excretion.—The bromides, which are rapidly absorbed by the mucous membranes, are promptly eliminated, mainly by the kidneys and to a small extent also in the perspiration and in the milk, so that a nursing infant may be affected. There is probably some excretion likewise by the bronchial and intestinal mucous membrane. The disagreeable odor sometimes noticed in the breath in chronic poisoning has been supposed to be due to the elimination by the lungs of bromine or some of its volatile organic compounds. The hydrobromic acid secreted into the stomach in bromism is thought to be all re-absorbed in the intestines. Some of the bromide is rapidly eliminated, as it can be detected in the urine a few minutes after ingestion, but the great mass of the drug is excreted very slowly. Therefore, under its continued administration there is an accumulation in the system, though it has been shown that the proportion excreted increases with the increase of the salt in the blood until an equilibrium is established, exactly as much bromine appearing in the urine as is absorbed from the stomach. After the discontinuance of the drug the excretion still goes on, and it has been detected in the urine for as long as sixty-five days later. The slow excretion of bromides is regarded as affording support to the theory that the bromine enters into combinations in the body, and it is thought probable that it may to some extent take the place of chlorine in the combinations of the latter, especially as the excretion of chloride is increased. The administration of sodium chloride, it is said, accelerates the excretion of the bromine, and ameliorates the symptoms of bromism; epileptics may substitute sodium bromide for sodium chloride in satisfying their desire for salt.

Comparative Action of the Bromides.—Certain of the differences between the various salts have already been referred to. None of the bromides has any action on nerve or muscle unless applied directly to the excised structures. Potassium bromide is more depressant to the heart and to the central nervous system than the sodium salt on account of the influence of the potassium-ion. The

depressant action of lithium bromide is next to that of the potassium salt, and may even exceed the latter in this respect. It is the richest in bromine, containing 92 per cent., and though it has not been so largely used as the others, is thought to have the most pronounced hypnotic influence of any. It is asserted that the strontium and calcium salts cause less disturbance of the digestion than the others, but they are apt to be absorbed more slowly by the intestine than those of the alkalies. Hydrobromic acid appears to have the characteristic bromide action after absorption, but it also has the local action of an acid; which makes it more irritant than the bromides. While pleasanter to take than the latter, it is, therefore, more apt to create gastric disturbance.

Therapeutics of the Bromides

External.—Locally bromine, not official, has been employed as a caustic in hospital gangrene, chancre and carcinoma uteri, but its escharotic action is attended with great pain. Before the days of cocaine anæsthesia it was customary to paint the pharynx with a bromide solution in order to diminish the sensibility of the throat before making a laryngeal examination.

Internal.—The bromides are of great service in various nervous diseases for the relief of which a **depressant effect** is required, being the most valuable remedies in the treatment of **epilepsy**; their good effects being probably due to their influence in reducing the excitability of the cortical motor areas. When pushed in a suitable manner, they sometimes prove curative, and though this happy result is by no means always to be looked for, they are in most instances of great service in diminishing both the frequency and severity of the attacks. Consequently, they may be said to be indicated in every instance of the disease, and their use should be abandoned only after a thorough trial has demonstrated their inefficiency. As a rule, they are more successful in instances of *grand mal* than of *petit mal*, and in patients in whom the seizures occur in the daytime rather than in those where they are exclusively nocturnal. Potassium bromide is the one in most general use, and it seems to be considered as on the whole the most efficient. There are special circumstances, however, in which some one of the various other bromides possesses certain advantages and may succeed when the potassium salt has failed. Sometimes the combination of the potassium, sodium and ammonium

bromides, acts better than any one of the salts alone. Belladonna often increases the efficiency of bromides in *petit mal*. As the bromides when applicable in epilepsy must be administered for an indefinite period, every effort should be made to minimize their objectionable effects upon the system. Thus, it is often advisable to intermit the remedy from time to time, or to change from one bromide to another. To counteract the depression, the bromide is sometimes given in infusion of calumba or digitalis, or strychnine is given hypodermatically at the same time. It has been claimed by some that most of the ill effects of the bromides may be avoided by giving them in combination with intestinal antiseptics, such as sodium salicylate and betanaphthol; while others have observed that taking strong coffee with the meals hinders the development of bromism. For the prevention or amelioration of acne, arsenic is the best remedy. When the convulsive attacks have ceased to make their appearance, it is advised that a single dose of 4 gm. (1 dr.) of bromide should be taken daily at bedtime for a year, and after that on alternate nights for at least a year longer. It is better that the remedy should not be discontinued altogether for fully three years. As **hypnotics** and for quieting nervousness and hysteria the bromides are often extremely useful, but their too long-continued employment should be avoided on account of the risk of the patient becoming an *habitué* of the drug. They are especially useful in the wakefulness of fatigue, worry and cerebral over-work. In various forms of convulsions both in adults and children they are efficient, particularly when combined with hydrated chloral. This combination may be useful also in delirium tremens. Here the dose of bromide should be very large, and it is of more service in the preliminary stage of wakefulness and excitement than after the delirium is fully developed. Other affections in which bromides may be employed are laryngismus stridulus, the night-screaming of children, migraine, dysmenorrhœa and menorrhagia, particularly in young subjects, seminal emissions, **satyriasis** and **nymphomania.** In migraine and neuralgia the combination with caffeine is often very efficient. They are of service in the laryngeal crises of locomotor ataxia and, in full doses, in acute laryngitis. In instances of irritability of the pharynx and larynx which interferes, with a satisfactory examination of these parts, this may be obviated by the administration of one or two full doses, instead of the local application formerly practised. They are the best prophylactics

as yet discovered for **seasickness**, and should usually be employed in doses of about 0.60 gm. (10 gr.) three times daily for several days before sailing, though a larger amount will sometimes be required. After seasickness has commenced they should be given in small doses, frequently repeated, in an effervescing draught made by mixing a solution of citric acid with one containing the bromide and potassium bicarbonate. They may also be used in the same way in the vomiting of pregnancy, that following etherization, and other persistent forms of vomiting which are not due to primary gastric disturbance. In instances where this method proves inefficient, the bromide may be given with the tincture of deodorized opium, in a small enema of starch water. The bromides have also been employed to prevent the nausea and depression resulting from opium, as well as for the symptoms of cinchonism and salicylism. They are of service in the abdominal neuroses, such as cholera infantum when it is due, not to improper alimentation or other local trouble in the gastro-intestinal tract, but to an irritable state of the nervous system. In some varieties of functional disease of the heart they are of decided benefit. Lithium bromide has been prescribed in various gouty and rheumatic conditions, and potassium bromide is recommended as an eliminating agent, combined with potassium iodide, in mercurial, copper and lead poisoning. In a considerable number of instances potassium bromide has proved successful in the treatment of tetanus. Not less than 15 gm. (½ oz.) should be given during the day, and hydrated chloral, in moderate doses, should be used as an hypnotic at night. This bromide, in full doses, is also of value as an antidote for **strychnine poisoning.** Hydrobromic acid was introduced as a substitute for the bromides, but it failed to fulfill the expectations of its usefulness. It has some repute in preventing the **untoward symptoms of quinine**, of which drug it is an excellent solvent. Thus, it is said to give prompt relief in the annoying *tinnitus aurium* occasioned by it, though it often fails in relieving tinnitus from other causes. It has been highly recommended for headaches due to eye-strain, especially in nervous women.

In general the bromides lessen nervous irritability, allay pain in over-sensitive individuals, inhibit various reflex activities as vomiting, diminish sexual excitation, as in nymphomania, prevent convulsions as in epilepsy, diminish spasmodic nervous affections as in chorera and other affections, lessen spastic conditions, and various forms of cardiac hyperæsthesia.

Bromism.—The name bromism has been given to chronic poisoning by the bromides. It is to be noted that hydrobromic acid although containing a larger proportion of bromine, very rarely gives rise to this condition. Usually the first symptom is an eruption of papular acne, which appears chiefly upon the face and back. In severe instances the papules suppurate and then the pustules may coalesce, forming small abscesses and eventually ulcers. In other instances the rash produced resembles eczema, and in still others there is erythema urticaria, even a bullous eruption, or merely a brown discoloration of the skin. The eruptions have often been mistaken for late syphilitic manifestations. A coated tongue and disordered digestion are constant symptoms. There is not infrequently some coryza, with or without an increased secretion from the bronchial mucous membrane, and sometimes a mild conjunctivitis. These various effects are regarded as due to a **local irritant action**, due in part to the salt action of the bromide and in part to the decomposition of the bromide, with liberation of bromic acid and bromine, by the free acids in different situations: as hydrochloric acid in the stomach, carbon dioxide in the air passages, and the acid secretions of the sebaceous glands in the skin. This action is said to be favored by insufficiency of the kidney and to be more readily induced in old age. As a matter of fact daily colonic irrigations do much to prevent the skin eruptions as well as other untoward symptoms irrespective of of the kidneys being impaired in function. From the influence of the drug on the nervous system, the general cutaneous sensibility and the sensitiveness of the faucial mucous membrane are distinctly reduced, while the sexual appetite also becomes markedly diminished, The patient is indisposed to make any exertion and is easily fatigued, while his gait is uncertain and every movement may be attended by tremor. The mental phenomena observed are of the nature of continuations and exaggerations of the effects of a single dose. The intellect is dulled and the memory especially is affected. The patient takes little or no notice of what is going on around him, he speaks slowly and stammers, and is apt to mispronounce ordinary words or omit several words from a sentence. The mental condition induces a stupid and apathetic expression of countenance, while the eyes become heavy and lusterless. Occasionally maniacal excitement, mental confusion, and even delirium are observed after continued use of moderate doses, particularly of the potassium salt.

Those who take bromides habitually generally find themselves unable to sleep without them, and as a gradual increase of the dose is required to produce sleep, the effects on the system are usually disastrous. It is usually preferable to keep the dose of bromide as small as possible when treating epileptics for long periods of time and risk the occurrence of an occasional convulsion than to subject the patient to the evils of pronounced bromism. In addition to suffering from the special evils of bromism, the patient, on account of his lowered resistance, is rendered more liable to contract disease of any kind, and not infrequently the immediate cause of death is an attack of pneumonia or bronchitis. Notwithstanding the gravity of the symptoms in bromism, after the withdrawal of the drug they generally disappear soon after there no longer remains any bromine in the system.

Drugs Acting on the Brain

1. General cerebral stimulants.

BELLADONNA

For the Preparations of Belladonna *see* p. 120.

Action of Belladonna

External.—The action of belladonna is due to the atropine in it. Atropine by itself is not absorbed by the unbroken skin, but when rubbed in with absorbable substances, such as alcohol, glycerin, camphor or animal fats, or when applied to abraded surfaces or mucous membranes, it has a well-marked local action and is capable of producing systemic effects. Its chief local effect is a paralysis of the sensory nerve terminations, so that it acts as an **anæsthetic,** and **anodyne,** and it also depresses the motor nerve terminations, though less markedly, and tends to inhibit secretion. On the peripheral vessels it has first a constricting and then a dilating influence. Applied to the conjunctiva, it is a typical **mydriatic.**

Internal. *Blood.*—Atropine is rapidly absorbed into the blood, and it is stated to diminish the number of leucocytes.

Nervous System.—The main action of atropine is on the nervous system, and most of its effects in the organism are due to its influence upon the various portions of this. The action extends from the hemispheres downward, and in the medulla oblongata the drug first stimulates and then depresses the three principal centers. Its

dominant and characteristic action is a **depression** of the **terminations** of most varieties of nerves.

Secretory Nerves.—On the activity of the peripheral terminations of all the secretory nerves in the body, it has a distinctly depressant effect. The secretions are not, however, all affected to the same extent, since with some of them the nervous influence is not so important as it is with others. The secretion of **saliva** is completely dependent upon the integrity of the nervous connection, and hence may be **entirely arrested** by atropine. Under the influence of the drug, stimulation of the chorda tympani, which is the secretory nerve of the submaxillary gland, no longer causes an increased flow of saliva, as under ordinary circumstances, and it has been shown by excluding the participation of the ganglia and gland cells that the action is on the nerve endings. Furthermore, it has been shown that no paralysis results of the vaso-dilator fibers which extend side by side with secretory fibers of the chorda tympani, the secretory fibers alone being selected by the atropine for its attack. In the same way the secretory nerve terminations in the other salivary glands and the buccal mucous glands are paralyzed, and as the normal impulses are thus prevented from reaching the gland cells, the mouth becomes dry. Even small doses of atropine will cause a considerable amount of dryness. From the same cause the secretion of the glands of the throat, nose and respiratory passages is stopped, and as a result there are produced **hoarseness** of the voice, **thirst** and **difficulty of swallowing.** The **skin** likewise becomes **dry** from the paralysis of the terminations of the nerves in the sudoriparous glands. While atropine **diminishes the secretion of milk** by the same process, it does not check its flow entirely, as the mammary gland has been found to continue to secrete after all its nerves have been severed. The solids of the milk are thought to be augmented rather than diminished. By its action in paralyzing the terminations of the secretory fibers of the pneumogastric nerve in the stomach, atropine diminishes or may even entirely arrest the secretion of gastric juice. The pancreatic secretion, although it is not entirely dependent on nervous impulses, is similarly affected; so that, after atropine, the increased secretion which ordinarily occurs upon the entrance of food or of acid into the intestine does not take place, while stimulation of the pneumogastric, which ordinarily increases it, has no effect. The bile is also said to be diminished, and it would seem probable that the in-

testinal secretions are affected likewise. Some diminution in the urine, as well as an alteration in the proportion between its nitrogenous constituents, has been observed after atropine, but it is unknown how far such results may be due to its action on the kidneys and how far to its effect on other organs. The amount of the urinary flow, as is well known, is largely dependent on the secretion of sweat. The flow of lymph is not affected by atropine, and from this fact it is inferred that this is not controlled by nerves in the same way as the true secretions.

Sensory Nerves.—The effect of atropine, when locally applied, in paralyzing the terminations of the sensory nerves is not observed from its internal administration, although some have claimed that the sensory terminations are first very slightly stimulated and then paralyzed by the drug.

Involuntary Muscles and their Nerves.—The innervation of all unstriped muscles in the viscera seems to be **depressed or paralyzed** by atropine. Hence the movements of the stomach, intestine, bladder, uterus, spleen, bronchial muscle, thoracic duct, and of the pupil and œsophagus (except in animals in which these consist of striped muscle) are more or less diminished by it. In the intestine not only is normal **peristalsis lessened,** but that which is caused by direct nerve stimulation, as by drugs such as physostigmine, is promptly arrested by atropine. Immediately after the injection of the atropine there usually occurs an increase in the intestinal movements. This might be cited as proof that it causes a preliminary stimulation of the nerve terminations, but may also be explained by the inhibitory endings being paralyzed earlier than the motor. Ordinarily the movements, although they become diminished, are not finally arrested since the intestinal muscle, like the other involuntary muscles, is capable of maintaining a regular movement independently of nervous impulses from without. Thus any irritating substance will cause peristalsis after the use of atropine, and the action of purgative drugs is not interfered with by it. It is a common practice to give belladonna in association with purgatives for the purpose of preventing griping, and the generally accepted explanation of this result is that the local contractions of the intestinal wall which are supposed to give rise to the griping are due to nervous influence, and hence disappear under the action of the drug.

Eye and its Nerves.—Whether atropine be dropped into the eye or given by the mouth, it has the effect of **widely dilating the**

pupil. This is due to paralysis of the **terminations of the motor oculi** nerve in the sphincter muscle. It is found that the paralysis is limited to the periphery, and that the muscle is not acted on is shown by the fact that it reacts to electrical stimulation. The pupil dilates because the elastic fibers of the iris have an opportunity to act. That the action is local is shown by its remaining confined to the eye, and even to that side of the eye to which atropine is directly applied. There is also a **loss** in the power of **accommodation,** and this is caused by paralysis of the motor oculi terminations in the ciliary muscle, so that near objects are no longer seen clearly. Atropine is, therefore, markedly **cycloplegic.** In addition, there is **increase of intra-ocular tension,** such as usually accompanies dilatation of the pupil, and this is probably due to the dilatation. The dilatation is found to be not quite maximal, since it is generally increased, though but slightly, by stimulation of the cervical sympathetic trunk. Atropine gives some relief from pains in the eye.

Homatropine hydrobromide appears to have much the same action as that of atropine, but it is less poisonous and its **mydriatic effects,** while more rapidly produced, are somewhat less complete.

Heart and its Nerves.—The inhibitory **terminations of the vagus** in the heart are **paralyzed** by atropine, although the vagus center itself is stimulated. Consequently the heart-beat is **accelerated,** and stimulation of the vagus does not produce any change in it. The amount of acceleration produced varies considerably with the age of the subject, the vagus being most active in middle life. In the new-born infant there is no quickening of the heart, but up to about 30 the acceleration increases with the age, and from this point on lessens again. Large amounts undoubtedly weaken and depress the muscle, and may cause arrest in diastole. Furthermore, atropine has some **stimulating influence on** the **cardiac centers** in the medulla oblongata. This action, however, is for the most part overshadowed by the peripheral effects, though it may induce a preliminary slowing of the pulse. The circulation always persists after the cessation of respiration, and its failure is therefore not the cause of death in atropine poisoning. Homatropine usually slows, instead of accelerating, the action of the heart.

Vaso-motor System and its Nerves.—Atropine causes a considerable **rise in blood-pressure,** an effect which is due in part to the acceleration of the heart-beat, and largely also to stimulation of the vaso-

constrictor center in the medulla oblongata, since it is much less marked after division of the spinal cord. This central stimulation has the effect of causing a contraction of the abdominal arterioles, which is accompanied by a dilation of the arterioles of the skin and probably also, it is thought, of the brain, from excitation of the vaso-dilator center. Hence there results a movement of blood from the abdomen towards the periphery; but as the dilation of the cutaneous vessels cannot altogether counteract the constriction of the abdominal ones, a rise in blood-pressure is induced. The dilatation of the surface vessels is most marked in the region of the head and neck, where it causes a pronounced **flushing of the skin.** In many instances there is observed a rash like that of scarlet fever, and the hyperæmia may be so intense as to lead to desquamation. That it is due to central action is shown by the fact that it is prevented by section of the cervical sympathetic trunk. The increased arterial tension is maintained for some time after small doses, but large amounts soon bring about a **fall** in the **blood-pressure** by its depressing action on the muscle fiber of the heart. Under toxic doses the pressure falls very low from paralysis of the vaso-motor center and arterial muscle, as well as of the cardiac muscle. The spinal vaso-motor centers are acted on in the same way as the medullary.

Respiration and its Nerves.—The respiration is often slow at first, from some central action the precise nature of which has not as yet been explained. Soon, however, in consequence of stimulation of the respiratory center in the medulla, the breathing becomes **quicker** and also probably **deeper,** and the amount of air inspired per minute is found to be considerably increased. Under large amounts of atropine the center is rapidly **depressed.** The respiration grows shallower and slower, and in fatal instances **death** results from **failure** of this function. Not infrequently the breathing is interrupted by convulsive movements, and in many instances it is never resumed. Both the afferent and efferent terminations of the vagus in the lungs are paralyzed by atropine, and not only is the bronchial muscle relaxed, but the secretions, which are diminished in quantity, are now less irritating in consequence of the depression of the efferent filaments. In this way the drug has the effect of **lessening cough.**

Central Nervous System.—The action on the central nervous system consists of a true **stimulation, followed by depression,** and if the amount is sufficient, paralysis. While caffeine affects chiefly the

higher divisions of the central axis, and strychnine the lower, the seat of the influence of atropine may be said in a general way to be intermediate as regards these. In the use of caffeine the highest functions of the cerebrum, the psychical, are involved first of all, but atropine acts principally on the motor divisions of the brain. Atropine is likely to cause restlessness, vertigo, garrulity, incoherence of speech, staggering gait, choreoid movements, uncontrollable laughter or weeping, a busy delirium, and mania. In the subsequent paralytic stage, drowsiness, coma, and finally convulsions may occur, the latter largely from asphyxia. In poisoning by it the medulla and spinal cord are involved, but in the cord the action is very much weaker than that of strychnine and appears much later. **Children** are much **less susceptible** to the influence of the drug than adults.

Temperature.—Atropine often causes a **rise of temperature,** which may amount to 2°C. (4°F.) or more, due considerably to the absence of sweating and seems to be independent of the blood-pressure and the diminished respiration, as well as of the convulsions. While the dissipation of heat is increased, probably because the flushing of the skin leads to a greater loss by radiation, the heat production is apparently increased to a still greater extent.

Elimination.—Atropine is largely oxidized and the remainder is excreted rapidly, principally by the kidneys, but it also passes into the milk and into the fœtal circulation. The uric acid of the urine is said to be diminished by it. In poisoning, retention and even suppression of the urine has been observed. After poisoning, sufficient atropine has been found in the urine to dilate the pupil.

Therapeutics of Belladonna

Externally.—Belladonna, and sometimes atropine, is used locally to relieve **pain** of all kinds, to check **sweating** and the secretion of milk, and to **relax spasm,** while atropine is largely employed in ophthalmological practice. For neuralgia, myalgia, lumbago, acute inflammations, and chronic rheumatism and other painful affections of the joints belladonna is often applied in the form of liniment, ointment or plaster. For severe local pain atropine is sometimes combined with aconitine or other alkaloids. The plaster is an excellent application to relieve the chest-pains of phthisis or to allay irritability of an over-excited heart; there can be sufficient of the drug absorbed from plasters to cause an eruption or even toxic symptoms. For

inter-costal neuralgia or pleurodynia, strapping the chest with belladonna plaster is usually the most efficient way of applying the drug. In the form of the plaster or ointment it is much used as an **antigalactagogue**. The liniment, applied several times a day, is of great service in restraining excessive local sweating, and a lotion or ointment containing belladonna may be successfully employed in pruritus, urticaria and chronic eczema attended with much itching. A suppository containing atropine alone or in association with opium, has been recommended in dysmenorrhœa dependent upon spasm of the cervix. A solution of atropine in chloroform (1 to 100), applied to the epigastrium on a piece of lint, will sometimes relieve obstinate vomiting, cerebral or reflex, such as that of pregnancy, seasickness, etc. In ophthalmological practice atropine is used to dilate the pupil and as a **cycloplegic** to relax or paralyze the accommodation in order to facilitate examination of the eye and determine its refraction, and also to destroy adhesions and to prevent contraction of the iris or its protrusion through an ulcer of the cornea. It has also been administered to relieve the pain in **iritis** and other pains due to intra-ocular conditions. If the iritis occurs in rheumatic patients with posterior adhesions it may act as an irritant. The solutions of atropine for such purposes, as well as for hypodermatic injection, should be freshly prepared and sterilized by heat each time, since it is not decomposed by even boiling water, in order to avoid the development of bacteria in the liquid. The sulphate is the salt commonly selected for dilating the pupil, and some such solution as the following may be employed: Atropine sulphate, 4; boric acid, 5; in water to 480. Atropine must not be used if the patient is suffering from glaucoma. In certain individuals even perfectly neutral solutions are very irritant, giving rise to what is known as atropine conjunctivitis.

Homatropine hydrobromide (*see* p. 122) is largely employed for the purpose of dilating the pupil in ophthalmic practice, and it has the advantage over atropine that the **mydriasis** passes off in less time. It is therefore better adapted for diagnostic purposes, while atropine is preferable when it is desired to keep the pupil dilated for some time, as in the treatment of iritis. Sometimes a solution in castor oil is employed, as being less liable to be washed out by the tears, but this may produce some irritation. When belladonna or its alkaloid are applied in ointment or other form to denuded surfaces, the pupils and throat of the patient should always be carefully watched.

Internal.—Belladonna or atropine is given to check salivation from the use of mercury or other drugs and the excessive **ptyalism** sometimes met with in children and pregnant women. It is one of the best remedies for the **night-sweats** of phthisis, and for checking this and other objectionable forms of sweating, atropine sulphate may be injected hypodermatically, or a solution of atropine sulphate in camphor water (1 to 100) be given by the mouth. For bromidrosis of the feet and other localized sweatings also the drug may be used internally, as well as externally. It has been employed in serous diarrhœa on the ground that it tends to check this by stimulating the splanchnic vasomotor filaments of the intestinal blood-vessels, the inactivity of which permits a transudation of liquid into the bowel. It is also given to overcome **constipation** and colic, and the extract of belladonna leaves is a frequent constituent of purgative pills. In peritonitis this extract is sometimes administered in frequently repeated doses in a pill with opium, for the purpose of paralyzing intestinal movements and thus assisting the action of the latter drug. In intestinal obstruction the propriety of administering atropine has given rise to much discussion. It is only in the paralytic and spastic forms that internal treatment would seem to be useful; in the former, small doses of atropine and in the latter large ones may be of service. In gastralgia, as well as the pain accompanying gastric ulcer, and in pyrosis, chronic gastric catarrh, and irritative dyspepsia, atropine often affords marked relief. It may also be of service in the vomiting of pregnancy and other reflex varieties of vomiting, when given by the mouth, as well as when applied to the epigastrium, or it may be more efficient if used in suppository. Sick-headache due to or accompanied by spasm of the arterioles, as indicated by pallor of the face, vertigo and *tinnitus aurium*, is frequently relieved by belladonna. It is also of service in the headache of young persons, often due to over-work, in which there is pain in the eyeballs and forehead. This drug is a valuable remedy in many cardiac affections. Thus, as it accelerates the beats of the heart without diminishing their force, it may be employed whenever it is desired to completely empty the ventricles. Its greatest service, however, is in relieving **cardiac pain** and distress. Here it may be applied over the præcordial region or given internally, usually as the tincture of the leaves. It is also useful in the treatment of shock and collapse from injury or in the course of disease, and in pneumonia particularly it should be resorted

to when after the crisis there is great relaxation of the vascular system and heart stimulants are found to be ineffective. Here the administration of atropine or belladonna will dry a moist skin and by increasing the vaso-motor tone often produce marked improvement. Given in full dose, it will not infrequently **abort colds** in which the pharynx is hot and dry and has a feeling of rawness, while the local capillaries appear injected and red. It is also of much benefit in acute coryza. In whooping-cough, given freely, and for other spasmodic affections of the respiratory passages it has been esteemed one of the most reliable remedies. Children can take proportionally large doses. In conditions, requiring the administration of the remedy for considerable periods, a tolerance has been established. For the symptom **asthma** it is of most service when combined with opium, and it may be given both during the attacks and as a prophylactic in the interval. Belladonna leaves rolled into cigarettes are often smoked by asthmatics, but the most effective way of administering the drug here is the hypodermatic injection of atropine. In bronchitis with a tendency to paroxysmal spasm the tincture of the leaves is frequently associated with other remedies. For the nervous cough of both children and adults belladonna is an excellent remedy. It is also useful in laryngismus stridulus and in hiccough. Atropine has been used with good effect in the aphonia caused by fatigue of the vocal cords and likewise in hysterical aphonia. In pneumonia it has been employed to **stimulate respiration.** That it prevents respiratory depression is the reason for its association in administration with morphine and other narcotic drugs. As a preliminary to general anæsthesia, it not only is used to stimulate the respiratory center but, when chloroform is used, to prevent early, excessive vagus stimulation, and generally to inhibit profuse secretion in mouth and throat and even in the bronchi. Belladonna is probably the most efficient medicinal agent we have for the nocturnal **enuresis** of children, and is also valuable in urinary incontinence in adults when this depends upon vesical spasm. It relieves enuresis because it has an anodyne effect upon the centers in the cord, and, when excreted in the urine, anæsthetizes the neck of the bladder. It is also sometimes useful in the treatment of nocturnal seminal emissions. Its property of relaxing the spasm of involuntary muscle is well shown in the relief which it affords in the acutely painful vesical spasm which accompanies urinary calculus, cystitis and

prostatitis, as a suppository or applied to the perineum in ointment or plaster, or it may be used both internally and externally. In urethral spasm and in chordee it may be given internally, and the ointment may be smeared along the under surface of the penis. By its action in relaxing spasm, belladonna will often give relief in the colic resulting from the passage of hepatic and renal calculi. It is possible that it may be employed to combat anaphylaxis in serum sickness. On account of the similarity of the symptoms of atropinism with those of scarlet fever, belladonna has been vaunted as a prophylactic against this disease, but the drug is absolutely valueless in this regard.

Although in the healthy individual this drug tends to induce wakefulness and busy delirium, yet in certain morbid states of the brain it appears to have a hypnotic action, and it is considered to be indicated in instances of mental disorder in which there are found a low state of the blood-pressure, deficient intracranial circulation, and a contracted pupil, with prostration and insomnia. Thus, a hypodermatic injection of atropine may overcome the insomnia of delirium tremens in instances where there are coma-vigil, great restlessness, and feeble heart-action, with coldness of the surface, blue skin, and a clammy sweat. Belladonna was formerly employed in epilepsy; even yet good results may sometimes be obtained from it in nocturnal epilepsy and *petit mal*, and in anæmic subjects, with cold extremities, dyspnœa, cyanosis, and weak heart. The subcutaneous use of atropine has been found particularly efficient in *tic douloureux* and sciatica, and to secure the best results it is advised that deep injections of the largest doses compatible with the safety of the patient should be made in the vicinity of the affected nerve-trunk.

TOXICOLOGY

Symptoms.—The most characteristic early manifestations of belladonna poisoning are dryness of the mouth and throat, dysphagia, and dilatation of the pupil, with dimness of vision, and mild cerebral symptoms. The skin is dry and the scarlatina-like rash may or may not be present. The conjunctivæ are injected and the face is flushed, while the pulse is very markedly quickened and the temperature more or less elevated. There is often nausea, and sometimes vomiting. There may be purging, but this is not ordinarily observed. Frequently the urine is voided at an early period, and after that there is a constant desire to micturate without the ability to do so. It has been suggested that the preliminary contraction of the bladder is analogous to that of the intestine, and the subsequent inability to empty it to the diminution of the peristalsis; anuria, however, may

be present. The patient is cheerful, loquacious and restless and staggers like a drunken man when he attempts to walk, and excitement, passing into delirium, is a prominent feature. The cerebral symptoms have already been sufficiently detailed. Convulsions are rare. The respiratory movements, which at first are slow and full, become quicker and shallower, from the depression of the medullary center. The breathing grows dyspnœic in character, and death at length takes place from respiratory failure. A fatal ending, however, is comparatively infrequent. If the patient should survive, it sometimes happens that he has no recollection of his illness. Scarlet fever and acute mania have been mistaken for belladonna poisoning, and with disastrous results. *Post-mortem.*—There is nothing characteristic about the appearances, which are simply those met with in asphyxia from any cause, the result of venous engorgement of the various internal organs.

Treatment.—Quite commonly the prognosis is favorable, as there is usually ample time for successful treatment. The stomach should be washed out or evacuated by emetics (*see* p. 380). The general symptoms are best treated by the hypodermatic injection of pilocarpine and the delirium by the application of an ice-cap to the head, with the addition of the bromides given internally. Ether may be used to control spasms, but chloroform, morphine and hydrated chloral, which are likely to hasten respiratory failure, should be withheld. In the stage of depression stimulants should be given subcutaneously and strong coffee by the rectum. Warmth must be applied to the surface and extremities, and artificial respiration may be called for. The effects on the eye may be counteracted by the local application of physostigmine, as well as by pilocarpine.

ANTAGONISM

The antagonism between atropine and morphine is discussed on p. 761. Morphine might, on theoretical grounds, be administered in the early stages of atropine poisoning, but its action on the respiratory center renders its use dangerous in severe instances, for the stimulation caused by atropine soon passes into depression, and the effects of the two drugs would therefore supplement each other. As a sialogogue, diaphoretic and myotic, pilocarpine completely antagonizes the action of atropine on the secretory nerve endings in the salivary and sudoriparous glands and the terminal filaments of the motor oculi nerve in the iris and ciliary muscle. Contraction of the pupil and spasm of the ciliary muscle are also induced by physostigmine, which in like manner stimulates the motor oculi terminations, and it is furthermore antagonistic to atropine in that it at once has a depressant action on the respiratory center.

STRAMONIUM

For the Preparations of Stramonium *see* p. 123.

Action and Therapeutics of Stramonium

The action of stramonium is practically the same as that of belladonna, although in poisoning by it, irregularity of the heart's action

is more marked. It also appears to relax the bronchial muscle more completely than belladonna. It is more toxic than the latter, and accidental poisoning by it, especially among children, is quite common.

Stramonium might, apparently, be employed for all the various purposes of belladonna, but it is not often used except to relieve the spasm of the bronchial tubes in instances where this produces the symptom asthma and where it is of very great value. It may be given internally, but most commonly the fumes from the burning leaves are inhaled from cigarettes or otherwise, and the drug is more beneficial when used in this way. For this purpose potassium nitrate, of which a solution is made and the leaves moistened by it and dried, or cubeb, lobelia or tobacco, may be added.

HYOSCYAMUS

For the Preparations of Hyoscyamus *see* p. 124.

Action of Hyoscyamus

As may be inferred from the alkaloidal composition of the drug, the action of hyoscyamus is very similar to that of belladonna and stramonium. There are some particulars, however, in which it differs, though the difference is really one of degree rather than of kind. Thus, under belladonna the primary stimulation of the central nervous system is usually very marked, while with hyoscyamus (an effect due to the influence of both its alkaloids) the stage of stimulation is much shorter, or may apparently be entirely absent. By its depressant action it may therefore produce drowsiness and sleep without any preliminary exaltation. Both hyoscyamine and scopolamine, as a rule, are powerful hypnotics, and the sleep caused by them very closely resembles natural sleep. It is to be noted, however, that in some instances this is preceded by a stage of excitement, with confusion and garrulous delirium, as in the case of atropine, while occasionally the hypnotic effect is almost or altogether absent. In fact, they may even have the opposite effect and cause insomnia. Scopolamine is even more depressant to the brain than hyoscyamine, and very small amounts are usually sufficient to induce sleep. As a rule, no confusion is complained of on awaking, but dryness of the throat and thirst are said to be often present. As regards the peripheral action, while inducing the same effects, it is believed that

hyoscyamine acts somewhat more powerfully on the heart, intestine, pupil and sweat-glands than atropine, while scopolamine appears to have a still stronger action on the peripheral nerve terminations than hyoscyamine, and produces no distinct quickening of the pulse. Scopolamine is generally believed to produce **mydriasis** and **loss of accommodation** more quickly than atropine, but for a shorter period, and according to some it acts more strongly on the pupil than that alkaloid.

Therapeutics of Hyoscyamus

The preparations of hyoscyamus are weaker than the corresponding ones of belladonna, and accordingly must be used in larger doses; in practice they are almost exclusively given for two special purposes. As the peripheral action of its alkaloids is more powerful than that of atropine, it has more effect in preventing local contractions of the intestine depending upon nervous stimulation, and thus **obviating griping**, and hence it is very largely given with purgatives on this account. In the same way, it has a more marked sedative action on the urinary unstriped muscle than belladonna, and accordingly it is also much used to **relieve vesical spasm** in the same class of affections in which belladonna is of service. It is very commonly prescribed with other urinary sedatives, such as buchu, uva ursi, or benzoic acid if the urine be alkaline.

Hyoscyamine and scopolamine are very powerful alkaloids and should always be administered with great caution, especially as the activity of different specimens varies; the latter is the less dangerous of the two but it so markedly depresses the respiratory and vasoconstrictor centers that it not infrequently leads to collapse. Both are used as **hypnotics**, especially in hospitals for the insane. They often act very satisfactorily in instances of mania, delirium tremens, hysteria, etc., and may also be given for the delirium of fevers as of pneumonia, especially in alcoholic subjects, and for severe insomnia. Scopolamine is the one more commonly used; it is generally given by hypodermatic injection and is often combined with morphine. Some patients, it is found, are not quieted by the drug, but pace up and down in a semi-insane condition till its action has worn off. It is considered of great value in spermatorrhœa and seminal emissions, owing to its anaphrodisiac properties. A certain degree of tolerance is produced by it, so that it is necessary to increase the dose from time

to time in the event that its use is continued for some time. Hyoscyamine often temporarily controls very efficiently the tremor of paralysis agitans, and it is at times very useful in the treatment of the morphine and alcoholic habits though it should not be given habitually in these addictions. It is used to some extent in ophthalmic practice and as a preliminary to general anæsthesia, favoring a tranquil mentality lessening the required quantity of ether and diminishing the secretion from the oral and respiratory tract, or even for general anæsthesia in connection with morphine, by hypodermatic injection. Many, possibly most, practitioners consider this practice to be both inefficient and not devoid of danger.

CAFFEINE

For the Preparations of Caffeine *see* p. 126.

Action of Caffeine

External.—Roasted coffee, especially in the form of powder, appears to have some deodorizing effect.

Internal. *Alimentary Canal.*—Coffee in small amounts is a stomachic tonic, owing to its bitter taste, and generally has a somewhat laxative effect; increasing, probably by reason of its volatile oils, the peristaltic movements of the intestine. The so-called biliousness sometimes caused by its habitual use is probably occasioned by empyreumatic substances, therefore, coffee from which the caffeine has been removed is just as likely to disorder the digestion. The excessive use of tea and, to a less extent, of coffee is liable to give rise to indigestion, acidity and heart-burn. Tea is more prone to produce injurious effects, partly perhaps because, as a rule, more of the former than of the latter is consumed, and also because the effects of the continued action of the tannic acid in the tea, and the larger amount are even more deleterious than that of caffeine; and it not infrequently induces chronic constipation and causes serious interference with digestion. The teeth of tea-tasters are very liable to decay.

Heart.—From laboratory experiments the effect of caffeine appears to consist in (1) an acceleration of the rhythm without further change; (2) a shortening of the movements, commencing in the auricle and spreading to the ventricle; and, in large doses, (3) auriculoventricular arrhythmia, terminating in fibrillary contractions of the

auricle, and finally of the ventricle. The primary acceleration would seem to be due to stimulation of the most irritable part of the heart, the so-called excito-motor apparatus; the second stage may be due in part to the acceleration, or to the action of the caffeine on the muscle of the auricle and ventricle, and may thus indicate that the influence of the drug has extended to less susceptible parts of the heart. The third stage is believed to be due to the ventricular irritability having been so greatly increased as to give rise to an idioventricular rhythm; the stimulant action on the cardiac muscle having extended to the ventricle. The interference of the two rhythms, then, explains the greater part of the variation in the strength of systole and the extent of diastole. With excessive doses follow fibrillary contractions in the ventricle; the previous appearance of these in the auricle appearing to indicate that the stimulant influence spreads to this before it reaches the ventricle. The action of caffeine thus appears to consist in a **descending stimulation,** which begins in the excito-motor area at the junction of the auricle and great veins, and extends into the auricles and finally to the ventricles.

Vessels.—Caffeine **stimulates the vaso-motor center,** and under its influence the blood-vessels are therefore contracted, causing a **marked rise in the arterial pressure.** The muscle-fiber in the walls of the vessels, in common with the muscles in general, is also acted upon by the drug. Under small doses the constriction of the arteries, which is of comparatively short duration, is followed by an expansion of much longer duration, but with larger doses the subsequent dilatation does not occur. It has been demonstrated that the vaso-constriction caused by the drug is principally the result of central stimulation by the fact that this effect is very largely interfered with by hydrated chloral, which paralyzes the vasomotor center.

Muscles.—Small doses increase the excitability of the muscles, augmenting the quickness and force of their contraction and **enables more work to be done.** Soldiers, well supplied with food, when given tea or coffee can endure more prolonged and severe marches than those who do not receive these articles. These results are undoubtedly due to the fact that caffeine increases the power for continuous physical work by increasing mental vigor, the control and extent of muscular work, and through the brain, the motor activity of the cord and directly the voluntary muscles. Under large doses, directly applied, to the muscle, the height of the contraction

is less, the maximum load it is capable of lifting is smaller, and it is exhausted by tetanus more quickly than a normal one, the contraction then becomes smaller and smaller, and it gradually passes into rigor.

Respiration.—Caffeine has a **stimulating** effect upon the **respiratory center** in the medulla, as is shown in the improvement in the respiration caused by it in instances of poisoning by alcohol, opium and other drugs, but less marked in the normal condition of the system.

Nervous System.—Caffeine is a **rapidly acting stimulant** to the cerebrum, medulla oblongata, and spinal cord, and has so few, if any, deleterious effects that it can be called a **physiological stimulant.** Here the blood-supply would seem to be an important part; probably the circulation in the brain is affected indirectly by the changes produced in the general circulation. In the cerebrum the drug affects the psychic functions and is without doubt the most certain and effective energizer to the intellectual faculties. Consciousness is enjoyed to the fullest extent, all drowsiness is banished, and the highest mental powers have full play. No emotional excitement is produced. The cerebral stimulation caused by it differs from that due to the opium in that the reasoning faculty is not less affected than the imagination and in that the excitation is not incoördinate. Caffeine acts, but in the opposite direction, on the same parts as are first affected by alcohol and other agents of its class. They are the centers which are also first paralyzed, to some degree at least, by morphine and cannabis. Caffeine is therefore an efficient antidote for these, and especially for alcohol, since the medullary and the spinal effects are also antagonistic. The sleeplessness often caused by tea and coffee is probably due in part to stimulation of the nerve centers and partly to the indirect effect of the dilatation of the cerebral blood-vessels caused by the constriction of the vessels of the body generally. In addition to tea and coffee, maté, cocoa, kola, guarana and the various other substances which have long been in use as beverages in different parts of the world all contain either caffeine or analogous alkaloids. They impart a sense of grateful refreshment, relieve fatigue, mental and muscular, and increase the capacity for physical exertion and endurance, without fatigue reaction. The effect of caffeine on the acuteness of the senses is shown by the greater accuracy of touch under its influence. While the results of the drug

taken in moderate quantity are of distinct **benefit in intellectual work**, excessive amounts are apt to render connected thought temporarily more difficult, as impressions follow each other so rapidly that the attention becomes distracted. These larger doses may over-stimulate the cerebral circulation, causing pain and a sense of fullness in the head, restlessness and insomnia, with more or less confusion of mind. The pulse may become rapid and irregular after very large doses and cardiac uneasiness or palpitation may occur and temporary wakefulness be induced. It is stated that such effects as these are induced only with difficulty in habitual tea or coffee drinkers; so that the continued use of small quantities of caffeine would seem to give rise to a certain amount of tolerance.

Kidneys.—Caffeine, in small doses, usually has a marked effect in **increasing diuresis.** It was formerly supposed that the diuretic influence of this agent was principally owing to an increase of cardiac energy which improved the renal circulation, but it is now known to be mainly due to direct action in stimulating the renal epithelium. The increased activity of the secretory cells occasioned by it is also accompained by a slight dilatation of the vessels of the part which is analogous to the vascular dilatation in a muscle undergoing contraction. Under the diuretic effects of caffeine both the solids and the fluids in the urine are increased, but the former to a less extent than the latter.

Metabolism.—According to some it causes a slight rise of temperature, partly by its action on the central nervous system, and more particularly by its direct muscular effects. In consequence of this it also increases the metabolism, that is, the production of urea and carbon dioxide. Caffeine is rapidly excreted in the urine in small quantities as such, but a considerable proportion of it is probably decomposed, with the formation of various xanthins, which are further broken up into urea.

Therapeutics of Caffeine

Heart.—In cardiac disease caffeine has been employed as a rapidly acting **stimulant** of great service in a variety of conditions; in instances of feeble action of the heart it does good by increasing the general blood-pressure, through its constricting influence on the arterioles, and thus producing a more efficient circulation. Its chief utility in heart affections, however, is in patients suffering from

dropsy, where by its marked diuretic action it proves highly efficacious in a considerable proportion of instances. It may often be combined with advantage with digitalis, strophanthus, or other drugs having a similar cardiac action. The preparations of caffeine are sometimes useful also when combined in sufficient amount with antipyrine or acetanilid derivatives to counteract their depressing influence upon the heart, but, for this purpose, strychnine is preferred. Caffeine, may sometimes, in neurotic subjects, but rarely, cause so much insomnia that its use has to be discontinued.

Kidney.—The physiological action of the drug shows it to be, within limitations, a diuretic of great value. It is a fact worthy of note in the therapeutic use of caffeine, that the diuresis is produced by smaller doses than those required for any other of its effects. This constitutes a point of great practical importance, for the smaller doses, while sufficient to bring about the desired effect on the kidneys, do not as a rule affect the central nervous system to such an extent as to cause an antagonistic vaso-constriction which so seriously interferes with the renal function. However, its effect upon the urine is somewhat variable, and in order to secure satisfactory diuresis it is therefore sometimes advisable to administer with it some such agent as hydrated chloral, which diminishes the excitability of the medullary centers. It should never be employed in acute inflammatory conditions of the kidney, because stimulants are contra-indicated when the part they influence is inflamed; but it is sometimes of service in chronic Bright's disease, especially when there is marked cardiac failure. When, however, the secreting cells are incapable of stimulation, it will naturally prove inefficient; so that in renal dropsy it may be said to be useful in inverse ratio to the amount of damage suffered by the kidneys. In simple cardiac dropsy, where it often acts so effectively, the epithelial structures are usually only passively congested.

Nervous System.—As a stimulant to the central nervous system, and especially to the respiratory centers, caffeine is of great service in instances of poisoning by opium and by alcohol. In the treatment of the former, strong black coffee has long been in use, and caffeine might perhaps be substituted for it with benefit. Hot coffee, however, has the advantage of adding to the heat of the body, which is apt to be quite cold. It has been ascertained by experiment that within

narrow limits there is a direct physiological antagonism between caffeine and morphine. In the insomnia of chronic alcoholism, caffeine, in small doses, given subcutaneously, has also been found useful. On the other hand, it is sometimes taken, in large quantity, to produce wakefulness and increase the vigor of the mental powers during their excessive use. So, in despondency and hypochondriasis and in neurasthenia it sometimes has a good effect. In migraine and other forms of nervous headache, such as **hemicrania**, not due to errors of refraction with or without gastric derangement, it is much used. In these affections it is not so efficient as antipyrine; but it may often be advantageously combined with the latter, and, in addition, sometimes with one of the bromides. Some observers have also found it especially efficient when given in connection with acetphenetidin. In trigeminal and other neuralgias, particularly when given in combination with some of the synthetic analgesics, it often affords relief. In the adynamia of typhoid and other acute fevers it may at times prove useful, either alone or as an adjuvant to alcoholic and other stimulants.

Alimentary Tract.—Caffeine is a stomachic tonic, improving the appetite and digestion, and it has been found of service in convalescence from various acute diseases. In dyspepsias and in chronic catarrhs of the stomach, in neurotic subjects, with occasional attacks of migraine it is often useful, especially in combination with nux vomica.

Respiration.—In certain instances of the symptom asthma it is of value; the paroxysm being promptly relieved by it; in many, however, it has little or no beneficial effect. In pneumonia or in congestion of the lungs, with weak heart, in elderly individuals, it is of material service.

The untoward symptoms are commonly met with in neurotic individuals. There may be increased reflex excitability and motor activity, and a too rapid flow of ideas for proper concentration. There may be some cardiac oppression and dyspnœa. Insomnia and general nervousness may supervene. These manifestations are more liable to appear in tea- than in coffee-drinkers, and rarely appear if the patient takes a sufficient amount of proper food. All of these symptoms may appear after the use of decaffeinated coffee and are more likely to be produced by the volatile oils and furfuric alcohol in coffee than by caffeine as such.

GUARANA

For the Preparations of Guarana *see* p. 128.

Action and Therapeutics of Guarana

Guarana is habitually used as a beverage by the South American Indians. Its effects on the system are mainly those of its alkaloid, guaranine, not official, which has the same action as caffeine, although it contains sufficient tannic acid to have an appreciable astringent influence from this.

It is employed almost exclusively for the relief of **headache,** especially that which recurs at short intervals, especially in women at the menstrual periods, and of that which follows a debauch, when the head throbs and eyes are bloodshot. In many instances, however, like most other remedies, it gradually loses its power over such attacks, and may eventually aggravate them. In the headache of chlorosis it is more efficient in combination with cannabis.

ALCOHOL

For the Preparations of Alcohol *see* p. 95.

Action of Alcohol

External.—Alcohol is antiseptic and disinfectant, but it has comparatively little bactericidal action at the temperature of the body. It is said that 50 to 70 per cent. alcohol is more destructive to germs than either stronger or weaker solutions. Curiously enough, it has been pointed out that many substances which are antiseptic when dissolved in water lose much of this property when dissolved in alcohol, and it seems to be an established fact that alcoholism, whether acute or chronic, actually predisposes to bacterial infection, and the power of resistance is diminished. Alcohol is both refrigerant and **rubefacient,** and is also slightly anæsthetic. Applied to the skin, it quickly evaporates; thereby cooling the surface, with the effect of temporarily constricting the superficial vessels and checking the secretion of the sweat-glands. If, however, evaporation is prevented, the alcohol, which has the property of extracting water from all tissues, promptly absorbs moisture from the skin, and thus has the effect of hardening it. Having passed through the epidermis, it exerts an irritant action, similar to that of the volatile oils, which produces a dilatation of the vessels and redness, itching and a sensa-

tion of heat in the part. Upon ulcers and abraded surfaces the irritant action is much more marked. The albumin is coagulated and there is first an astringent and afterwards a corrosive effect, until the alcohol becomes diluted by the fluids of the wound.

Internal. *Mouth.*—Upon the mucous membrane of the mouth and pharynx concentrated solutions cause effects similar to those on the skin when evaporation is prevented, but there is more of a **burning sensation** produced, and at once also there results, from reflex action, an increased flow of saliva and possibly a quickening of the pulse. Then follows a slight local anæsthesia, and if the alcohol is held in the mouth for some time, the mucous membrane becomes whitish and opaque, from coagulation of albumin and abstraction of water from the tissues. This soon disappears, as solution of the albumin again occurs.

Gastro-intestinal Tract.—In the stomach also a burning sensation is produced by concentrated solutions, and large quantities give rise to so much local irritation that nausea and vomiting are caused. A more rapid secretion of both the acid and solids of the gastric juice and augmented gastric peristalsis have been observed in instances of gastric fistula, and it has generally been found that the **digestion is promoted.** In some instances, however, in which observations on the duration of gastric digestion with and without alcohol were made, it was found that the process was retarded, instead of being accelerated, by this agent. In general, it may be said that alcohol in moderate amounts, and well diluted, tends to favor the process of digestion through an increased secretion of gastric juice, increased gastric movement, and increased absorption. With a percentage above 20, these are found to be counteracted by the lessened action of the enzymes; so that the actual result will depend upon which of these two —the beneficial irritant or the deleterious anti-ferment action—predominates. Small amounts of diluted alcohol taken at meals, it would seem, therefore, may be of service in promoting it. The psychic effect of alcohol and its primary effect upon the gastric mucous membrane, by producing irritation, is to **increase the appetite,** and this explains the quite common custom of taking a little alcohol just before meals. However, large amounts, or of a strength of more than 20 per cent. may injure the secreting cells of the stomach, produce a thick coating of mucus or even act as an astringent. It is well known that the systemic effects of alcohol are more rapid

and much more pronounced by its reception into an empty stomach. Fortunately fashion now dictates the milder alcoholic beverages, as appetizers, in place of the abominable mixtures of high alcoholic strength and of unknown composition but of presumably adulterated and sophisticated forms of alcohol. Furthermore, the **local anæsthetic effect** of alcohol may at times prove useful in **relieving** gastric **pain.** Alcohol is unique in that it causes the gastric glands to secrete when it is introduced into the small intestine or even into the rectum. It would seem, therefore, that it may act generally throughout the whole intestinal canal, to stimulate the flow of the gastric juice. In addition, alcohol by promoting the latter, indirectly promotes the pancreatic secretion also, since it has been shown that the chief stimulus to the flow of pancreatic juice is the action of the hydrochloric acid of the gastric juice upon the wall of the duodenum. In this direction, diluted alcohol in moderate quantities also aids absorption of food substances. The ingestion of a single dose of alcohol in concentrated form, as pure brandy, is immediately followed by pronounced **reflex effects.** Thus, the action of the heart is accelerated and increased in force, the blood-vessels generally, and particularly those of the skin, become dilated, giving rise to a feeling of warmth throughout the body, and the blood-pressure rises. The respiration is also quickened. These reflex effects, which are not produced by dilute forms of alcohol, such as beer, are well shown in the immediate restoration of a fainting person by a dose of brandy. They are quickly followed by the action on the circulation of the alcohol after its absorption into the blood. The repeated use of large amounts of alcohol leads to persistent congestion of the mucous membrane, and, if long continued, to chronic gastritis. The activity of the gastric juice is soon impaired and afterwards lost, the gastric glands atrophy, an excessive amount of mucus is secreted, and the permanent dyspepsia of drunkards results. How far these results are due to the alcohol is by no means established. The various secondary alcohols, esters, ethers, and other aromatic substances, found especially in wines, certainly have an effect, not yet determined, in producing pathological changes, particularly in the liver. Doubtless many of the organic alterations in various organs which have been ascribed to alcohol are really due to these substances. At any rate small quantities of alcohol well diluted, even if ingested for long periods of time do less harm than a few excessive doses of

strongly alcoholic beverages. In the intestines alcohol ordinarily has a slightly astringent effect. In drunkards, however, there usually results a catarrhal enteritis, as well as gastritis.

Metabolism.—About 90 per cent. of the alcohol, if the amount is not excessive, absorbed from the alimentary tract is found to undergo combustion. In so doing it gives up energy to the body, and is therefore to be considered as a food, although the mere fact of its liberation of energy does not constitute it an advisable food in all conditions. Alcohol ceases to be a food when it is ingested in such large amounts that it cannot be completely oxidized. In this instance the excess is likely to be harmful. Taken in addition to the ordinary food, alcohol is either itself transformed into tissue, or undergoes oxidation in the place of some substance which in turn is utilized to build up the body. It is a familiar fact that in the human subject habitual drinkers evince a marked tendency to obesity. It is evident, therefore, that to some extent, at least, alcohol acts as a substitute for fats and carbohydrates in the food. While, however, it is well known that these principles can, without any injurious effect, be substituted for a certain amount of the nitrogenous food required by the system, it is as yet a question how far alcohol, although undergoing combustion in the tissues and leading to the deposition of fat, is able to replace the fats and carbohydrates in their relation to nitrogenous metabolism. It sould seem that while alcohol really tends to prevent the waste of fats and carbohydrates, it is probably of less value than the latter in economizing nitrogenous waste; so that if alcohol is used as a food it should be associated with a diet rich in albuminous matter. Under these circumstances it is believed to be capable of replacing to some extent the ordinary food-stuffs. The only way in which alcohol, in moderate amounts, is supposed to have any action on the tissues is as a food, since the oxidation of the tissues, as measured by the absorption of oxygen and exhalation of carbon dioxide, is affected only in the same way as by any other food. When excessive quantities of alcohol are taken, the combustion of the tissues is first greatly augmented by the violent movements, characterizing the stage of excitement, but later it becomes reduced from the lessening of the muscular movements in consequence of the stupor and depression induced. Naturally, fats are saved from combustion by the oxidation of alcohol by the tissues, and it is thought possible that the energy which would ordinarily be expended in their

oxidation, is diverted to that of the alcohol. The observations on the effect of alcohol in moderate doses on nutrition have led to the following conclusions: (1) With a diet on which the individual gains in weight, the addition of alcohol lowers the rate of increase; (2) when added to a diet on which the weight remained constant, it tends to cause a loss of weight; (3) with insufficient diet, it lessens the loss of weight, or may even cause a gain.

Blood and Circulation.—On the leucocytes of the blood it has the effect of first augmenting and then reducing the amœboid movements; while as regards the red corpuscles it interferes with the ready yielding up of their oxygen by the oxyhæmoglobin, and thus tends to retard oxidation in the tissues. There is always a quickening of the heart during the excitement of alcoholic intoxication, but there is reason to believe that this is due to the increased muscular movement, rather than to any direct action on the heart. It has been shown that in normal patients the pulse-rate is unaffected by alcohol, provided that no excitement be produced by the environment, unless a very large amount of alcohol is administered. In that instance there is induced weakening of the auricular systole and afterwards of the ventricular, with distention of both cavities and slowing. It has been pointed out that these effects are similar to those caused by ether and chloroform, though the influence on the heart is very much less marked than in the use of these drugs. Whatever action alcohol has as regards the heart appears to be on the cardiac muscle; one of the first effects of alcohol on the heart is diminished efficiency and weakness of the contractions. In alcoholic intoxication one of the most noticeable features relating to the circulation is the flushing of the cutaneous surface, attributed to dilatation of the vessels of the skin, but it is undetermined whether such dilatation is the result of stimulation of the dilator centers or paresis of the vaso-constrictors. This action apparently has very little effect on the general blood-pressure. A marked fall in this is caused by very large amounts of alcohol, which weaken the muscular tissue of the heart and depress the vaso-constrictor centers; but no such effect is to be expected from medicinal doses. In fever the heart is frequently slowed by the administration of alcohol, probably due to its effect in diminishing cerebral excitement, rather than to any direct action on the heart. In shock, whatever improvement in the circulation may follow the use of alcohol is to be attributed to the reflex influence from its local irritant action.

It would appear that the reputation which alcohol has long enjoyed as a cardiac stimulant is not altogether supported by fact; but, at the same time, there can be no question that it is often of value in circulatory disorders for this reason, if for no other, that by its cerebral action it tends to lessen anxiety and other mental symptoms.

Respiration.—During the excitement of alcoholic intoxication the respiration is usually quickened, and this may be due simply to the increased muscular activity, rather than to a stimulation of the respiratory center in the medulla. Such excitement is not induced by therapeutic doses, but the evidence goes to show that without this, the amount of air inhaled is generally increased by alcohol, and such increase has even been noted where a well-marked narcotic effect was present. At present it is impossible to say whether the augmentation of the air inhaled is due to direct action on the respiratory center or to reflexes arising from the stomach, to both of which agencies it has been attributed by different observers. This is a question of practical importance in instances in which the respiration is insufficient, for, if the augmented respiration is caused only by the local action in the stomach, this indicates that much of the surplus oxygen is used in doing the work of absorbing the alcohol, and that the rest of the body profits to a correspondingly small extent from the increased aëration. On the other hand, if the air inspired is augmented in a greater ratio than the products of the increased activity of the alimentary tract, as is the fact when the respiratory center is directly stimulated, the advantage to the organism is correspondingly great. On the whole, it would seem that while the use of alcohol as a respiratory stimulant if not actually supported by experimental investigation, is nevertheless not to be entirely condemned.

Nervous System.—Alcohol is very generally regarded as a central nervous stimulant, which first excites and then depresses the cerebral and other cells. The clinician, in applying the term stimulant to alcohol, wishes to indicate only the improvement often noted in the general condition, without considering whether this is due to an augmentation or a retardation of the mental processes. The view generally accepted in the medical profession is that alcohol is a powerful stimulant, and that the increased functional activity which it induces, especially in the nervous system, is followed by a period of diminished activity or depression; furthermore, that alcohol, like many other drugs, acts on the higher functions first, so that the

stimulation and the subsequent depression proceed in a descending scale from the highest or least firmly fixed function to the lowest or most firmly fixed, in accordance with the law of dissolution (*see* p. 682). In the highest centers the special effect produced by alcohol appears to depend on the nature of their activity in the individual. In many individuals moderate amounts increase the facility of speech and in exceptional instances the brilliancy of thought. It must be acknowledged, however, that some of the highest functions of the brain are thrown out of action by doses of the drug which induce the phase of exhilaration. Thus, while a person may show greater brilliancy in conversation and generosity of sentiment, he is apt to lack that consideration for his own position or that of others which he ordinarily manifests, and to lose his self-restraint, his sense of responsibility and his power of discrimination. Such results would be explained, according to the stimulant theory, by the brief period during which the activity of the highest centers is augmented; so that the power of judgment becomes abolished very early, while the imagination, the emotions, and the power of speech are still in increased activity. These various functions then successively fail in the order named, and after them the muscular movements, commencing with the more delicate, become first incoördinated and then paralyzed. If the quantity of alcohol taken is sufficiently large, the reflex activity of the spinal cord next becomes abolished, and the bladder and bowels are evacuated involuntarily. The comparative immunity from injuries in falling, etc., which is often noted in drunken people is believed to be due to the depression of the reflex centers of the cord since the heart and respiration, on account of the general central depression, are not affected reflexly by them. After the spinal centers, the respiratory center in the medulla fails, and finally the heart may be paralyzed and death result. A fatal poisoning, however, is exceptional, and generally recovery takes place after a prolonged sleep. This is deep and torpid, passing into total unconsciousness, with slow and stertorous breathing, while the face, which has hitherto been flushed, grows pale or cyanotic. If unconsciousness continues for more than twelve hours, a fatal result is almost certain to occur. It has been conclusively shown that soldiers supplied with alcoholic liquors are less capable of long marches and suffer more from fatigue than others without them, and, in addition, that the capacity for forms of work, in which more mental activity is required than by

marching soldiers, is lessened by alcohol. Thus, when even a small quantity of alcohol is allowed, typesetters do a less amount of work and make a larger number of errors than when they are not supplied with it, while students exhibit a diminished capacity for mental work and less ability to keep the attention concentrated. The tendency toward sexual excess frequently observed after alcohol is not due to any influence upon the generative organs themselves, but to the loss of control from the cerebral action of the drug.

Temperature.—Small doses of alcohol have no effect on the body temperature, although, in consequence of the dilatation of the gastric and cutaneous blood-vessels induced, they cause a sensation of warmth both internally and on the surface. Moderate amounts **cause a fall** of 0.5°C. (1°F.), without causing intoxication. The reduction of temperature is believed to be due chiefly to a loss of heat from the dilatation of the cutaneous vessels. This is usually accompanied by a feeling of warmth, and a thermometer applied to the skin may actually show a rise of several degrees, in consequence of more warm blood flowing through the vessels. If much excitement and movement are caused by the drug, the increased heat resulting may counterbalance the augmented output; so that there may be no fall in the temperature, and in some instances even an elevation may be observed. Narcotic doses generally cause a fall amounting to from 3° to 5°C., (6° to 10°F.) which is due to the lessened movements during unconsciousness and may last for a considerable time. During exposure to cold a more marked reduction of temperature than under ordinary conditions appears to be caused by alcohol, in consequence, perhaps, of its rendering the heat-regulating mechanism less sensitive. Alcohol is, therefore, very unsuitable for a person who is to be exposed to severe cold. Besides, it causes drowsiness, and in this way dangerous results and even death may occur from a free indulgence in liquor under these circumstances.

Skin.—Alcohol is a mild **diaphoretic,** the action of the sweat-glands being augmented by the dilatation of the cutaneous vessels and also possibly by some direct influence on the glands.

Kidneys.—Alcohol has some **diuretic** influence. Some of the spirituous liquors, such as gin, induce free diuresis, but this is owing to other constituents rather than the alcohol.

Excretion.—The small percentage of alcohol, which is not oxidized in the tissues is excreted unchanged, principally by the lungs

and kidneys and to a very much less extent in the sweat and milk. The exact amount thus eliminated varies with the quantity taken. If the amount ingested is very large, about 0.3 per cent. escapes in the milk, but if moderate, none. The popular notion that an infant may become intoxicated or acquire a taste for spirituous liquors from the alcohol absorbed in the milk of a drunken wet-nurse is without foundation in fact. Both the amount and quality of the milk are said to be unaffected by the administration of alcohol. When medicinal doses are taken, it is found that the quantity excreted through the lungs amounts from 5.5 to 6.5 per cent., and through the kidneys at most from 1 to 2.5 per cent., while none is eliminated by the skin. Alcohol has been demonstrated in the blood for twenty-four hours after intra-venous injection of large quantities.

Therapeutics of Alcohol

External.—Alcohol is used as an **evaporating lotion for** sprains, bruises and local inflammations generally. Headaches are often relieved by the refrigerant and anæsthetic effect of alcohol when used in form of eau de Cologne to bathe the forehead, and spirit lotions, in consequence of their effect in constricting the cutaneous blood-vessels, may be of service in checking undue sweating. Brandy is a good application for hardening the skin for the prevention of bed sores. The rubefacient property of alcohol may be availed of for promoting the absorption of inflammatory products, or for the relief of pain in such affections as myalgia and chronic rheumatism, by rubbing it in the skin in the form of the soaps and other liniments into which it enters. A little brandy held in the mouth will also frequently relieve toothache. Properly diluted, alcohol may be employed as an astringent and antiseptic gargle or mouth-wash in pharyngitis, stomatitis, scurvy, salivation, etc. Concentrated alcoholic preparations are of service in the treatment of frost-bite, and certain vegetable parasitic diseases.

Internal.—Used with careful discrimination, alcohol is one of the most valuable remedies we possess, although the tendency of modern practice is to restrict its use. It is not to be recommended in acute dyspepsia, hyperchlorhydria, hypersecretion or gastric ulcer, as it is then apt to be irritant to the gastric mucous membrane, but given before or with the meals it is in many instances of service in increasing the **appetite** and improving the **digestion**, especially in the sedentary,

aged and feeble, and in instances of exhaustion from acute disease or over-work. On account of its anæsthetic effect, alcohol may relieve gastric pain, and it is also sometimes useful in allaying nausea and vomiting, particularly when given in the form of champagne or of brandy in small doses with effervescent mineral waters. When in delirium tremens nothing is retained in the stomach, so that the patient's life may be endangered on account of the lack of nutriment, a little brandy and ice will sometimes enable the stomach to receive and digest the food so urgently needed. In diarrhœal affections, in adults as well as children, brandy is, at times, very useful. Alcohol may relieve intestinal as well as gastric colic, but gin and hot water has too often been relied upon by old nurses in the flatulence of children when proper attention to the feeding would have prevented the indigestion. Alcohol is of immense advantage in many instances of **febrile disease,** where during critical periods it sustains the vital powers by supplementing the insufficient quantity of nutriment which the system is capable of appropriating and at the same time stimulating the digestion, and thus enabling the patient to dispose of an increased amount of food. It is advisable under these circumstances, therefore, that it should be given with milk, broth, eggs or other suitable aliment. It is by no means adapted for all varieties of fever, and hence its effects should always be carefully watched. If under its use the pulse becomes stronger and fuller, the tongue and skin less dry, the respiration less embarrassed, the delirium and subsultus less marked, and the patient grows more tranquil and disposed to sleep naturally, the drug is doing good. Although it is not given as an antipyretic, in instances in which it thus acts beneficially it will usually be found that the temperature is more or less reduced by it. On the other hand, if the fever rises and the other effects produced are the opposite of those just mentioned, the alcohol is doing harm and should be discontinued. While it is often given when it is quite unnecessary, there are many instances in which it is of inestimable value in such affections as typhoid and typhus fevers, pneumonia, small-pox, cholera and diphtheria, and also in gangrene, pyæmia, septicæmia, etc. It is likewise of the highest usefulness to arouse and support the flagging powers in sudden depression of the system, and may be given by the mouth, by the rectum, hypodermatically, or applied to the external surface with friction. It is thus resorted to in shock, syncope, severe hæmorrhage, and poison-

ing by tobacco, digitalis, antimony, and similar poisons. In **poisoning by phenol** it not only serves to tide the system over until the poison is eliminated, but prevents the latter from ionizing, therefore constituting the best antidote in these cases. The beneficial effect of the reflex stimulating action of alcohol on the circulation is well shown in instances of fainting or collapse where a single dose often promptly revives the patient. Alcohol may be said to be indicated, in general, whenever adynamia is a pressing symptom, and should then always be employed, tentatively at least, unless there are special circumstances present which render its administration unadvisable. In acute diseases frequently, and more rarely in chronic conditions, it is given with excellent effect in quantities which in health would cause intoxication and altogether disastrous results. In many instances of tuberculosis and other wasting diseases it is a remedy of the greatest service, lessening tissue-waste, promoting constructive metamorphosis, favoring the deposition of fat, and in general tending to retard the progress of the disease. The narcotic effect of alcohol on the nervous system may be employed to relieve pain, to promote sleep, and to quiet delirium, but except in the presence of acute disease it should be resorted to, for these purposes, with the greatest possible discriminating judgment, on account of the patient's moral welfare. When given as a diuretic, it is usually in the form of gin, in which its effect is greatly augmented by the juniper contained in this liquor. Although but little alcohol is excreted by the kidneys, its abuse, particularly in the form of ardent spirits, is one of the recognized causes of chronic Bright's disease. In all inflammations of the urethra it seems to be irritating, and in the treatment of gonorrhœa is always interdicted to the patient. Beer is regarded as particularly harmful. Among the other contra-indications for the use of alcohol may be mentioned acute nephritis, all states of cerebral excitement, unless due to exhaustion, apoplexy, meningitis, aneurism, advanced atheroma, and the alcoholic habit.

Tolerance is produced by the continued use of alcohol, and hence it is necessary to prescribe much larger doses for habitual drinkers than for other persons.

TOXICOLOGY

Acute Poisoning.—Very large quantities of alcohol are capable of causing instantaneous death by reflex arrest of the heart, but such a result is rare. Commonly they induce a torpid sleep, which gradually deepens into a condition like

that seen in chloroform anæsthesia, and which may end in death, usually from respiratory failure. In some fatal instances convulsions have preceded death. When the patient is first seen in the advanced stage of deep coma, the absolute diagnosis of acute alcoholic poisoning cannot be made.

Treatment.—The usual treatment, after emptying the stomach and bowels is the administration of tincture of capsicum, 1; compound tincture of lavender, 4; with aromatic spirit of ammonia to 16; in teaspoonful doses every one or two hours. Occasionally the use of the bromides is necessary.

Chronic Poisoning.—Among the more common results of chronic poisoning by the drug are chronic gastritis, cirrhosis of the liver, delirium tremens and mania. A great variety of other serious diseases have been attributed to its effects, among which may be mentioned gout, peripheral neuritis, pachymeningitis, organic heart disease, and chronic nephritis. There are, in fact, but few organs and tissues not in some way changed in chronic alcoholism, and its results, from their frequency and importance, claim the attention of practising physicians. It need only be said here that the changes met with have been classified under two groups, sclerosis and steatosis. While these anatomical alterations are developing, the exterior of the body assumes characteristic appearances. The subject may either be pale and flabby, but fat, with a heavy and imbecile expression, or have a dusky red or purplish, pimply and bloated skin, with bulging under the eyes, yellow and injected conjunctivæ, and blue and swollen lips. Nervous and mental derangements are common. There is a lack of energy, loss of will-power, dissatisfaction with the world in general and one's self in particular. Peripheral neuritis is by no means rare, associated or not with Korsakoff's psychosis. Alcoholics are especially liable to contract pneumonia, tuberculosis and other infectious diseases, and when attacked by them show lessened powers of resistance. They are also bad subjects for surgical operations.

Treatment.—This means the gradual withdrawal of alcohol, promoting elimination, quieting the nervousness and relieving the insomnia by the temporary use of morphine and scopolamine, and feeding the patient with whatever food his stomach can retain. In order to effect a cure it is necessary to eliminate the material or psychic cause for the addiction, to place the patient in the best possible physical condition, and to increase his will-power and self-respect. If the patient ireally desires to be cured the result is not difficult to attain with or without isolation and restraint. It is unfortunate that a great part of the treatment for alcoholic addiction is in the hands of ignorant, avaricious and generally vicious charlatans, and deplorable that these should be abetted by physicians of otherwise good repute. If the family physician will treat his patient intelligently from the theoretical standpoint, and give sufficient attention to psychic details there is no reason for failure in the majority of instances.

CANNABIS

For the Preparations of Cannabis *see* p. 125.

Action of Cannabis

The action of cannabis has many features in common with that of opium. Its principal influence is on the cerebrum, and it is regarded

as perhaps the most **powerful stimulant** of the **psychic functions** known. It is largely employed for this purpose in the Orient, generally in the form of *haschisch*, and its moderate use does not appear to be attended by any injurious effects. When taken to excess, it leads to tremor and loss of appetite and strength, and sometimes to mania and dementia. In some patients convulsive attacks have been observed, and among the natives of India catalepsy is said to occur. Death from acute poisoning is extremely rare, and recovery has taken place after enormous doses. In the influence of cannabis upon the nervous system depression is mixed with the stimulation in a manner similar to that which is occasionally seen in the use of morphine. Within a short time after taking it the patient experiences the most pleasurable emotions. Everything seems to amuse him, and he becomes hilarious and indulges in actions which he may know to be ridiculous but which he cannot restrain. **Double consciousness** is now well marked; in fact that *ego* may become a severe critic of the *alter ego*. In the exuberance of his spirits he feels on the best possible, and even on affectionate, terms with everyone about him. He passes into a dreamy, semiconscious state, in which, while the judgment is practically lost, the imagination runs riot. All his ideas are on a grand and magnificent scale; time and space seem to be indefinitely extended. His conversations may be brilliant but there is little continuity in his thought, which changes rapidly from one subject to another. Delightful visions pass before him in an endless phantasmagoria. True hallucinations are sometimes present. The general sensibility is much diminished, and this effect may deepen into complete anæsthesia. The pupil is usually somewhat dilated. As he becomes more profoundly influenced by the drug the dreams alternate with periods of consciousness, and eventually there results a tranquil sleep. From this the patient usually awakens without any feeling of depression, but refreshed and with an acute sense of hunger. Occasionally, in the midst of the pleasurable thoughts there is experienced a feeling of impending danger or other disagreeable sensation, and in some instances melancholia precedes the stage of sleep. In the Caucasian race the primary stage of exaltation may be quite short, and is sometimes altogether absent, deep sleep coming on after a preliminary feeling of heaviness and drowsiness, with noises in the ears and numbness of the extremities. It is a well recognized fact, however, that the effects of canna-

bis may vary greatly in different persons, due largely to individual peculiarities and also in part, no doubt, to the varying strength of the preparations of the drug. While the habitual use of the drug in large amount may lead to grave psychic disturbances, it does not appear to cause constipation and the same disturbances of nutrition as opium. Some, however, assert that while a single dose does not usually produce constipation, and may even have a slightly laxative effect, after long-continued administration there is a tendency to constipation. Dryness of the mouth, thirst, nausea, vomiting and strangury are untoward effects occasionally seen.

It would appear that the habit has been introduced into this country and its devotees are in considerable number.

Therapeutics of Cannabis

While the physiological effects of this agent constitute a very interesting study, it is not of great therapeutic importance, since almost any indication that it might be reasonably supposed to fulfil can be more satisfactorily and certainly met by other remedies. As a cerebral depressant it has been employed to **allay excitability** as after sexual or alcoholic excesses, and in many other conditions; in most of which it has been abandoned. As a hypnotic it is unreliable, producing sleep in only about one-half of the patients, although it will frequently produce sleep even when pain is present. Often there is excitement without sleep. It might be used, however, where opium is contra-indicated, and also as a substitute for it in some mental diseases. As an **analgesic** it is sometimes of service in migraine and neuralgia, although it not infrequently fails to afford relief. Cannabis enters into the composition of various preparations which are more or less used as anodynes and hypnotics and are sometimes of great service in bowel troubles. When prescribing the tincture, the resin from which is precipitated by the addition of water, it is necessary to employ mucilage to suspend it, while the taste is usually concealed by spirit of chloroform. The tincture of cannabis is now standardized biologically which should lessen some of the disappointments met with in its therapeutic application in the past.

2. General cerebral depressants.

OPIUM

For the Preparations of Opium *see* p. 113.

Action of Opium

External.—The effects of opium being due almost entirely to its morphine, the two may be studied together. Opium, however, may be less sedative than morphine owing to the fact that it contains the alkaloid thebaine, not official, which resembles strychnine in its action. Though locally it has been said to possess feeble analgesic properties, opium probably has no action when applied to the unbroken skin; but from mucous membranes and raw surfaces it is absorbed, and it then exerts a marked anodyne influence, due to the central action of the drug, as the sensory nerve endings appear to be in no way affected by it.

Internal. *Secretions.*—Most of the **secretions** are **diminished** by opium. The sweat, however, appears to be increased in consequence of dilatation of the cutaneous blood-vessels. Opium tends to check the secretion of saliva, but when nausea is caused, both the saliva and sweat are often markedly increased in consequence of this condition. In the last stages of opium poisoning the perspiration is sometimes profuse, but this is simply a result of the asphyxia. It is not known precisely what effect the drug has upon the bile or the pancreatic secretion. The urine is scarcely affected by it, though, in consequence of the absence of the sphincter-reflex, retention in the bladder not infrequently occurs. So far as known, all the other secretions are diminished.

Alimentary Canal.—Unless the dose is very small, dryness of the mouth and a feeling of thirst are promptly caused. Whether administered by the mouth or not, opium tends to produce **nausea and vomiting,** and to **impair** the **digestion,** possibly due to its alkaloid anarcotine, not official, which has nauseant properties. The nausea and vomiting would seem to be probably due in part to peripheral and in part to central action, although this may partially be due to spasm of the pylorus. When morphine is given by subcutaneous injection, it is quickly excreted into the stomach, and yet the great rapidity, with which vomiting sometimes follows its administration

in this way, points to an action on the medullary center. Small quantities of opium lessen the sensation of hunger, and this is probably due rather to central action than to a local influence on the stomach. Because of the lessened perception of hunger and the gastric derangement, the appetite is diminished. Opium causes diminution of intestinal peristalsis and **constipation,** in consequence, probably, of some peripheral action, such as lessening of the irritability of the vagal terminations and splanchnic inhibition, delay in the passage of food which permits of more perfect digestion and more perfect absorption and, possibly, to ileo-cœcal spasm similar to the tonic spasm of the pylorus. Not only does it tend to check the movement of the bowels, but it **abolishes or mitigates** abdominal **pain** when present. Large doses provoke diarrhœa which is probably of central origin.

Circulation.—Small doses have little or no effect upon the heart and circulation. With either large or small doses, however, there may be some quickening of the pulse at first, in consequence of nausea. Large amounts cause **slowing** of the **heart** through primary stimulation of the vagus center in the medulla, as well as by an action on the cardiac motor ganglia. At the same time, from some obscure central action, the cutaneous vessels dilate. This gives rise to a **full pulse** and to a sensation of warmth in the skin, which may be followed by itching or discomfort, but has little influence on the general blood-pressure. The latter generally remains high, and the circulation is only greatly depressed quite late in the poisoning. While such depression is dependent to a considerable extent on vasomotor paralysis, it is no doubt largely secondary to respiratory failure. The heart finally stops in diastole, but death is rarely due to the effects of the poison on this organ or its nervous apparatus.

Respiration.—The respiration is slowed and at first deepened, but the increased depth is not sufficient to counterbalance the slowness of the breathing, so that the air inspired is reduced. Later the respirations become not only shallow but irregular, and may assume the Cheyne-Stokes type. **Paralysis** of the **respiratory center,** to which opium acts as a **direct poison,** is the usual cause of death. The bronchial mucus, like the secretions in general, is diminished by opium.

Nervous System. Brain.—The action on the cerebrum consists for the most part of a **depression** of the **higher functions.** In man, owing to the greater development of the brain, the narcotic effect of the drug is much more pronounced. The depression is usually

preceded by a **stage of excitement,** characterized by restlessness and increased mental activity, the length of which varies greatly in different individuals; but in some instances this appears to be entirely lacking. As a rule, it is found that the period of excitation can be maintained for a considerably longer time by the administration of small doses at frequent intervals, while under the effect of a single large dose it is short or absent, and deep sleep very soon comes on. During this first stage the imagination is often stimulated, the fancy has free play, and the creative powers are augmented, while the attention, judgment, coördination of the brain, and reasoning faculties are less keen than ordinarily. In exceptional instances, however, the intellectual power and mental vigor are increased. The general effect seems to be that of a **series of stimulations and depressions** going on at the same time but whether these successively involve the same or different centers is unknown. Different parts of the brain appear to be affected in different degrees and at different intervals of time, so that these act in a dissociated manner and more or less independently of each other. It is well recognized that the symptoms are greatly influenced by individual susceptibility and by race, and among Oriental peoples the stage of excitement is generally much more prolonged than in Europeans. It is often difficult to detect any evidence of stimulation of the cerebral motor centers, but the depression of these is never so pronounced as that of the intellectual faculties. It is true that the patient, in consequence of the debility and muscular weakness present, seeks a recumbent posture, but he can be walked about if he is supported. He feels in a most contented frame of mind, and sooner or later **sinks into a sleep** which is generally filled with dreams, often of the most fantastic character, though in some individuals it is entirely free from dreams. If the dose is large, the slumber is more apt to be dreamless. If it is not a poisonous one, the patient can be easily aroused, but under toxic amounts he soon sinks into complete coma. Opium is not only a powerful hypnotic, but the **most perfect analgesic** known. The dose required to annul pain naturally depends largely upon the severity of it. After small doses of the drug, patients generally awake refreshed, though exceptionally there is a little languor, dryness of the throat, headache, and possibly nausea. In some instances the headache is quite severe and accompanied by nausea, vomiting and depression.

Medulla Oblongata and Spinal Cord.—The principal effect in the medulla is the profound depression of the respiratory center. The

other centers are much less affected, and in instances of fatal poisoning this is paralyzed before the centers of cardiac inhibition, pupil-contracting, and vaso-constriction are depressed to any marked extent. There is, however, a distinct depression of the vomiting center, so that, although vomiting may perhaps be at first induced by its transient irritation, emetics do not act well in opium poisoning. The spinal cord is but little affected except by large amounts; mostly there is **depression** of its **conducting** and **reflex functions**, but in a few instances, after large doses, there have been observed increase of reflex excitability and twitchings or convulsions of spinal origin. After poisonous doses, the failure of the respiration closes the course of the intoxication. Opium sometimes has an aphrodisiac influence, and this has been attributed in part to stimulation of the cord and in part to the effect on the imagination.

Nerves and Muscles.—Except when given in enormous doses, the drug has no effect upon the peripheral muscles and nerves. The sensibility of the skin is lessened by an injection, but this appears to be a result of central action, since no more effect is produced at the point of application than elsewhere. In its general effect upon the nervous system opium affords a excellent example of the law of dissolution (*see* p. 682).

Pupil.—One of the characteristic effects of the drug is **contraction of the pupil**, and this is a central and not a peripheral action, since it does not occur after local application, nor after division of the nerve-trunks going to the iris. It is at once overcome by the application of atropine to the conjunctiva. After large doses of opium the pupil is reduced to the size of a pin-head, but in fatal poisoning it often becomes widely dilated shortly before death and remains dilated, as a result of the asphyxia.

Temperature.—Sometimes opium causes a slight preliminary rise of temperature. In most instances it occasions an inconsiderable fall, which is probably attributable to the lessened movements, as well as the dilatation of the cutaneous blood-vessels, and possibly the heat center in the brain is rendered less sensitive by the drug.

Skin.—Opium causes some increased secretion of sweat, though its diaphoretic property is not usually very marked. As the effects of the drug are passing off, redness and itching of the skin are sometimes observed, and in susceptible individuals the erythema may lead to exanthemata, such as an eruption of small spots resembling roseola.

Metabolism.—The metabolism is ordinarily lessened as a result of the quiet condition of the subject caused by the drug, so that the excretion of carbon dioxide is diminished in consequence of the depression; there is also a lessened excretion of nitrogen. In consequence of the impairment of respiration, there may be an increase in the lactic acid of the blood and urine, and glycosuria may be present, while glycogen may disappear from the liver. In patients suffering from diabetes the amount of sugar in the urine is diminished. Transient albuminuria may occur after opium, and it has been suggested that this may possibly be due to vaso-motor changes affecting the circulation of the kidney. In chronic morphinism also there is diminished metabolism, but this is probably attributable for the most part to the derangement of digestion.

Excretion.—Opium is excreted chiefly by the digestive tract, in the salivary, gastric and intestinal secretions, and is found in large amount in the fæces. As morphine has been detected in the stomach in two and one-half minutes after the subcutaneous injection of 0.03 gm. (½ gr.), there appears no question that the drug is capable of reabsorption from the gastro-intestinal tract. Traces of the drug have been found in the urine, but only after large doses. It is thought that a certain amount of it may perhaps undergo partial oxidation in the tissues, since oxidation products have been observed in the urine. It is also excreted to some extent in the milk of nursing women, so that it may cause morphinism in the child. The substances which produce the characteristic odor of opium are excreted largely by the urine and less freely by the breath, sweat and milk.

Peculiarities.—In some instances, instead of having a soothing influence and putting the patient to sleep, it produces sleeplessness and excitement, which may amount to delirium. In others it causes marked nausea and vomiting, gastric pain, and indigestion, often with very severe headache. Some of these bad effects may very likely be due to the varying composition of the drug, but certain individuals present such a pronounced idiosyncrasy against opium that it cannot be administered to them in any form without very unpleasant results. Children and also the very old are much more susceptible to its influence than adults of middle age, so that it must always be given to them with great caution, and women are, as a rule, more easily affected by it than men. Among the other untoward effects of opium may be mentioned diarrhœa, dyspnœa, aphrodisia,

fever and hyperidrosis. The tolerance of the drug by the system is remarkable, so that persons who use it habitually are soon able to take enormous quantities with impunity, so far as any immediate danger to life is concerned. The explanation of the tolerance is believed to be the increased power of the body-cells of the organism to oxidize the poison, and also an increased resistance of the cells toward morphine.

Differences in Action between Opium and Morphine.—These are as follows: (1) Morphine is absorbed more rapidly, and hence acts more quickly. It is therefore especially adapted for subcutaneous injection, and, administered in this way, it produces its effects with great promptness. (2) Opium is more apt to interfere with the digestion, although it is claimed by some that it causes less nausea than morphine. (3) Opium is more liable to cause constipation. This is both on account of the greater local action of crude drugs as compared with alkaloids, and because it remains in the intestine for a longer time than morphine. Consequently, it produces a more pronounced effect there than elsewhere in the economy, and this fact is availed of in the treatment of many abdominal diseases. (4) Opium has greater diaphoretic properties. (5) Morphine is more certain, as well as more rapid, in its anodyne and hypnotic effects. (6) Morphine is less convulsant. (7) Opium is thought to have a stronger effect in reducing the sugar in the urine when glycosuria is present. (8) Opium affects the bladder sphincter less. (9) Morphine causes more pruritus. (10) Morphine is excreted more readily.

Differences in Action between Codeine and Morphine.—Codeine is much less toxic than morphine, which it somewhat resembles in general character. While it is powerfully analgesic, however, its hypnotic influence is quite limited. Small doses induce light sleep, but somewhat larger ones are apt to cause restlessness and more or less exaggeration in the reflex excitability. It is much less depressant to the higher cerebral centers than morphine, and has a decidedly stimulating effect upon the spinal cord, as well as the medulla and parts of the brain. Owing, it is believed, to its action on the cord, tetanic spasm is sometimes caused by large doses. It is much less constipating than morphine, and has comparatively little effect in slowing the respiration, and, although the pupil is slightly contracted while the sleep which it causes, lasts, yet dilation is observed when

the stage of excitement follows. It is much less likely to produce a habit. Codeine is largely excreted by the kidneys.

Therapeutics of Opium

External.—Local applications of opium to relieve pain are often empoyed, but as the drug has no effect on sensory nerve terminations, the practice must be regarded as simply a concession to a popular sentiment. The apparent results obtained are no doubt due for the most part to the absorption of the drug from wounds or mucous surfaces. An ointment of opium and nutgall (1 to 14) is much used to relieve the pain of hæmorrhoids and anal fissures; here the drug can be absorbed because it is applied to mucous membrane.

Internal. *Gastro-intestinal Tract.*—Morphine, which is here preferable to opium, is of much value in relieving the pain of organic disease of the stomach, ulcer and cancer, as well as of irritative dyspepsia. It may be given in solution and it is also much used in combination with bismuth, zinc and silver salts in painful gastric diseases. Opium is often of great service in acute gastritis, where it is advised that it should always be given in liquid form, preferably as the deodorized tincture. Many forms of **vomiting,** whether of peripheral or reflex origin, are checked by morphine, and it is likely to prove useful after the stomach has been emptied in instances of vomiting caused by irritant matters. In colic, and especially lead colic, it often relieves the pain without increasing the constipation; while allaying the spasm of the intestine, it does not appear to entirely stop its peristalsis. In **diarrhœal diseases** opium is of the greatest possible value, but it must be used with discrimination and judgment. In acute diarrhœa due to irritating food and in mucous diarrhœa it is advisable that before using it the bowel should be cleared by a purgative. When the evacuations are watery, it may be combined with advantage with a mineral acid. In acute dysentery it is generally most efficacious after the preliminary administration of magnesium sulphate or other saline. It is frequently given by the rectum either in an enema with starch or milk or in suppository. In chronic dysentery it is the most reliable remedy, and may be employed in association with the salts of zinc, silver, copper or arsenic. In malarial dysentery, particulary, Patna opium, which contains over 6 per cent. of anarcotine, generally called narcotine, an antiperiodic, is especially indicated in combination with arsenic. In cholera morbus the hy-

podermatic injection of morphine is of great service, but in cholera infantum any form of opium must be used with great caution on account of the danger of producing narcosis. In cholera it is useless in the stage of collapse, but may prove of benefit in the preliminary diarrhœa, and it is an important ingredient of the various so-called cholera mixtures. In intestinal colic and abdominal pain of whatever origin, opium generally affords relief, and it is largely used in the treatment of peritonitis and other inflammations and after operations or wounds of the abdomen, but the better practice is to keep the bowels slightly open by the use of salines. When the opium treatment is employed in peritonitis, so that the paralyzing of the intestinal movements prevents the peritoneal surfaces from rubbing against each other, extensive adhesions are quite likely to result. As mercury is regarded by many as of special value in modifying inflammations of the serous membranes, particularly if combined with opium, it is a common practice to give calomel with the opium, at least for some time. As a rule, opium does harm in all gastro-intestinal affections in which there is a deficiency in the proper secretion, or a suspension of the functions of the liver and kidneys. Its most important use is to **check peristalsis** in instances in which this is therapeutically indicated. At the same time, the hypodermatic injection of morphine, by the action of the drug in relaxing spasm, is invaluable for the relief of the agonizing pain accompanying the passage of biliary and renal calculi, and is also of service in controlling the vomiting which is often present.

Heart.—Aside from its use in quieting a **nervous heart** or resting a diseased one, it is quite probable that in small doses, administered hypodermatically, morphine is a cardiac stimulant. At all events, is often acts very happily in the pain and distress caused by disease of the heart, and its cautious subcutaneous injection may be tried in all forms of cardiac dyspnœa. It is especially indicated if the patient, while perhaps able to breathe quite easily when awake, suffers from marked distress as soon as he falls asleep. Opium or morphine given by the mouth are usually much less efficient in affording relief in heart-trouble than morphine administered in this manner. The pain of aortic aneurism and intra-thoracic growths, like pain in general, is relieved by morphine. It is quite customary to give the drug in association with small doses of atropine, as it is found that its analgesic effect is increased rather than diminished thereby,

while the sleep resulting is less disturbed and more nearly approaches normal sleep. In addition, the atropine serves to counteract some of the depressing effects upon the heart and respiration and also to largely prevent subsequent headache, vertigo and nausea, as well as constipation. It has been shown that in the use or chloroform for anæsthetic purposes a hypodermatic injection of morphine, just before the inhalation begins, prolongs the stage of narcosis with a less quantity of chloroform, diminishes the danger of cardiac paralysis, and tends to prevent the after-nausea and depression. The same is true as regards other anæsthetics, and especially in persons addicted to alcoholic stimulants and for exceptionally neurotic patients, the preliminary morphine injection renders the anæsthetization safer.

Vessels.—Although not acting directly upon the vessels or blood, opium is most valuable as an internal hæmostatic. This effect is largely in consequence of the quietude secured by it, which allows the blood to coagulate in ruptured vessels. When, as is frequently the fact, the hæmorrhage is attended by marked restlessness, the drug is absolutely indicated because of its sedative effect both on mind and body. It is especially efficacious in gastric and intestinal hæmorrhage, where its influence in diminishing peristalsis is of material service, and also in pulmonary hæmorrhage. In hæmatemesis and hæmoptysis the benefit derived from it is in no small measure due to its controlling of vomiting and coughing, both of which are apt to bring on fresh bleeding. A very good preparation to use is powdered opium, as a pill, in combination with lead acetate. Hypodermatic injections of morphine are preferred by some, and when these are used they should be repeated at regular intervals as long as further hæmorrhage, or the risk of it, continues.

Respiration.—Opium, on account of its depressant effect upon the medullary center, must be given with caution in respiratory diseases, but in selected patients it is of marked benefit. An incipient catarrh may often be aborted by a full dose of Dover's powder. In bronchitis with excessive secretion very small amounts of opium may be sufficient to diminish its amount, as well as allay cough. If, however, the secretion is scanty and tenacious and expectoration difficult, opium may aggravate the condition. In pleurisy and pneumonia it is of great service in controlling cough and relieving pain, but the tendency to asphyxia in serious diseases attended with cough must always be borne in mind. Opium should therefore never be used in

the last stages of pneumonia and bronchitis. By its antispasmodic properties it is frequently efficient in arresting the symptom asthma, but its use here, as well as in other chronic respiratory diseases, is objectionable on account of the danger of inducing the opium habit. It is a very frequent and useful ingredient of expectorant mixtures, and among the preparations commonly employed in the treatment of cough are paregoric, Dover's powder and the compound liquorice mixture.

Nervous System.—Opium is unrivalled in its influence in **relieving pain** from whatever source and in inducing sleep when insomnia is due to pain. For these purposes the hypodermatic injection of morphine is usually preferred, as acting more promptly and certainly and less liable to cause nausea or digestive disturbances than opium or morphine given by the mouth, and atropine sulphate is often added to the solution injected for the purpose of minimizing as far as possible any ill-effects of the morphine salt. Morphine is of great value in relieving the after-pains of labor, and may be of service in spasm of the bladder sphincter and spasmodic stricture of the urethra by its action in relaxing the muscular contraction. Opiates are also commonly resorted to in cases of threatened abortion. It is manifestly impossible to detail the many applications of opium or morphine as an **analgesic** and **hypnotic** but it is obvious that its use should as a rule be restricted to acute or rarely recurring conditions, on account of the great danger of the patient's contracting the habit. For the relief of pain, anxiety and insomnia in incurable diseases, as cancer, for example, however, the judicious employment of the drug for an indefinite period is entirely justifiable. Enormous doses are often borne by patients suffering from very severe pain without the development of any indications of poisoning. Morphine is sometimes an efficient sedative in delirium tremens and other forms of mania, but not infrequently such large quantities are required as to render it an unsafe remedy. In acute mania small doses are said to be the most efficient if the arterial tension is low, but if the pulse is quick and the blood-pressure high, the full effect of the drug is necessary. Large hypodermatic doses require the utmost circumspection, especially in obese and aged subjects. In delirium tremens hydrated chloral is usually a more satisfactory hypnotic than morphine. In melancholia excellent results have been claimed from the use of opium in small doses, and here the best form for its administration is the tincture.

There is reason to believe that the hypodermatic injection of morphine is of value in many cases of **puerperal eclampsia**, and its use appears to be growing in favor. It has also been advocated for the relief of uræmic convulsions when due to acute nephritis, whether puerperal or not, on the ground that it tends to arrest muscular spasms by counteracting the effect of the poison on the nerve-centers, to establish profuse diaphoresis, and to facilitate the action of cathartics and diuretics. In hysteria it is not as efficient as various other remedies, and is especially objectionable from the risk of its inducing the opium habit. In pachymeningitis and basilar meningitis opiates in small doses seem to accomplish more than other remedies, and the hypodermatic injection of morphine in quantities sufficient to relieve the pain and rigidity is considered of value in the earlier stages of cerebro-spinal meningitis. When effusion has taken place and stupor and coma supervene, opiates are no longer of use. In conditions of increased excitability, such as tetanus, strychnine poisoning, and epilepsy, opium has been found on the whole to be harmful. Still, it is one of the most efficient of all remedies for relieving spasm of varied origins. Severe hiccough is very commonly arrested by a hypodermatic injection of morphine. As opiates are as completely absorbed from the rectum, if the latter be thoroughly cleared, as from the stomach, it is often advantageous to administer them in enemata or suppositories. Since the absorption is slower, however, the dose should be twice or possibly three times as large as when they are given by the mouth. In surgical practice opium has always been extensively used to prevent or mitigate **shock**, as well as to relieve pain and check or alleviate inflammation. In surgical operations, while it quiets the nervousness and aids anæsthesia, it depresses the respiratory center and is likely to provoke acute gastrectasis, if given before the procedure. It is certainly safer, if given for this purpose, when combined with scopolamine. There seems to be no question that it not only relieves existing shock, but is a potent factor in the prevention of secondary shock. It is the first remedy called for when pain or hæmorrhage is present, and the hypodermatic injection of morphine is strongly indicated in shock following injury, especially if an operation is required. It is an inestimable boon in severe burns, and it is particularly indicated in fractures, where it not only allays the immediate pain, but brings about muscular relaxation and relieves many distressing symptoms.

Kidneys.—Several instances of chronic nephritis are on record in which death was apparently caused by quite small doses of opium. It is the part of prudence, therefore, to use it with great caution in cases of chronic Bright's disease. Still, ample justification is afforded for its judicious employment, notwithstanding the apparent risk, by the marked relief which often attends the hypodermatic injection of small amounts of morphine in the uræmic dyspnœa, uræmic insomnia, and cardiac dyspnœa so likely to be met with in the course of this affection. Its employment in uræmic convulsions should be limited to those due to acute nephritis.

Skin.—Dover's powder is of considerable utility as a diaphoretic. It is commonly given in acute muscular rheumatism, and at the onset of "colds" and febrile attacks of various kinds, and will often be effectual, particularly if its action is aided by hot drinks and a hot foot-bath.

Metabolism.—Opium and its derivatives are acknowledged to have a favorable effect in many instances of diabetes, not only materially diminishing the amount of sugar in the urine, but also often causing an amelioration in the general condition of the patient, partly because of the rest of body and mind and increased sleep. Opium has apparently a beneficial influence, the precise nature of which is not very clear, in all sorts of inflammations, and particularly those of the serous membranes.

Codeine is frequently used for reducing the amount of sugar in the urine in diabetes, which it often does more effectually than opium itself. For this purpose it is usually given as a pill or in a syrup. It is very efficient in relieving cough of all kinds, and is an excellent and generally a preferable substitute for opium or morphine, but in relatively much larger doses, as an ingredient of expectorant mixtures. It does not so markedly constipate nor depress the respiratory center. It is also very useful for allaying ovarian pain and as an analgesic generally, and is especially esteemed, where, as often happens in malignant disease, an anodyne effect is required to be maintained more or less continuously.

TOXICOLOGY

Acute Opium Poisoning.—The symptoms usually appear within one hour after opium has been taken by the mouth. As might be expected from the effects of the drug upon the central nervous system, they are those of profound narcotism. Drowsiness may or may not be preceded by some slight excitation,

and as a rule it supervenes very quickly. The drowsiness passes into sleep, from which the patient may be aroused, but soon this deepens into stupor and eventually into complete coma, in which excitability is abolished and no stimulation of any kind has the slightest effect. A characteristic phenomenon is the extreme contraction of the pupils. The countenance, at first flushed, becomes pale and then cyanotic, while the lips are livid. The general surface is cold, and as the poisoning advances, becomes bathed with perspiration. In the earlier stages the pulse is apt to be full, slow and laboring; later it becomes so weak as to be almost imperceptible. The breathing gradually grows slower and more stertorous, as well as irregular. The limbs are relaxed, but death, which is due to respiratory failure, may possibly be preceded by asphyxial convulsions. The pupils may dilate shortly before death. The fatal result may occur in from two to ten hours. Even when coma and convulsions have developed, recovery is possible, and then the coma passes insensibly into a condition of slumber which not infrequently lasts for from twenty-four to thirty-six hours. The patient is apt to suffer from much nausea, headache and nervousness.

Diagnosis of Poisoning by Opium.—(1) *From Alcoholic Poisoning.*—This is often very difficult, especially when the patient has taken alcoholic stimulants, and it is important that a correct history of the patient should be obtained, if possible. Points of difference are that in opium poisoning the pupils are more minutely contracted and the patient can be aroused with less difficulty. The breath usually has a characteristic odor after opium, though not after morphine, but this may be obscured by the smell of alcohol if this has been taken. An examination of the urine may perhaps be of service in determining the true condition present. (2) *From Cerebral Hæmorrhage.*—If the pupils are unequally dilated cerebral hæmorrhage is present. If such hæmorrhage has its site in the pons Varolii, the resultant contraction of the pupils may render the differential diagnosis very difficult, and local paralysis should be carefully looked for. When hemiplegia is present, the recognition of cerebral hæmorrhage is easy. With a small hæmorrhage, and especially in the pons, the temperature may be elevated, while with a large one, this is lowered for the first few hours, though it may rise afterwards. (3) *From Phenol Poisoning.*—While here there may be coma and contraction of the pupils, the characteristic odor of the drug is present and its caustic effects may be observed upon the mucous membrane of the mouth. The urine is dark and smoky, and gives little or no precipitate with barium chloride. (4) *From Chloroform and Ether Poisoning.*—The smell of the breath and of the matters vomited will be a sufficient indication that the coma is due to one of these drugs. (5) *From Uræmia.*—In uræmia the presence of albuminuria, even if no other sign of Bright's disease can be detected, will show the nature of the disease. The odor of the breath is also characteristic in uræmia. (6) *From Diabetic Coma.*—Here the odor of the breath is likewise characteristic, and sugar will be found in the urine. (7) *From the Comatose Stage of an Epileptic or other Fit.*—In this condition the lividity of the face does not become progressively more marked, and the pupils are as a rule dilated. The history of the patient, if obtainable, is also of service.

Post-mortem.—The appearances are simply those characteristic of asphyxia. If death is due to opium, and not its alkaloids, the odor of the drug may be

detected. The condition of the pupils varies in different instances. The gastric mucous membrane is sometimes found to be reddened.

Treatment.—The stomach should be washed out, not merely once, but repeatedly, and at short intervals, because the morphine which has been absorbed is re-excreted into the stomach. On this account the evacuation of the latter is called for whether the drug has been taken subcutaneously or not. Prompt emetics (*see* p. 380) should also be given, and especially apomorphine hydrochloride hypodermatically. If narcosis has already set in, however, the action of emetics may be materially interfered with. Potassium permanganate, well diluted, has been successfully used, in an amount double that of the alkaloid ingested; it almost immediately destroys the latter, through its chemical action. It is claimed that it can act upon the poison when in the blood, so that a hypodermatic injection of it even for some hours after its ingestion may afford relief, but it is probable that it is efficient only on the portion of the poison present in the stomach. The reports have been so generally favorable that potassium permanganate should be used immediately. It has been recommended that atropine sulphate (.003 gm.; 1/20 gr.) should be given hypodermatically, and repeated every fifteen minutes; but great caution must be exercised with the use of this antidote—if, indeed, it should be employed at all. Instances of recovery from opium poisoning followed by death from the atropine given as an antidote have been observed. Some advise that .006 gm. (1/10 gr.) of atropine sulphate should be given as soon as possible, and not repeated. Caffeine, especially in the form of strong, black, hot coffee, is one the best antidotes, and given in this way tannic acid is also useful. Coffee may be administered by the mouth, and an enema of ½t (500 mils; 1 pt.) should also be given. Every effort should be made to rouse the patient and keep him awake, especially by walking him about, as the constant movement contributes to the better tone of the medullary center. Flapping with a towel, pinching, etc., may also be resorted to, as well as such general reflex stimulants as the application of the interrupted current, cold affusions, the inhalation of ammonia, and the hypodermatic injection of ether. The patient should be kept warm, and artificial respiration may be called for. Oxygen or amyl nitrite inhalations are sometimes of service. The treatment must be kept up for several hours, if necessary.

Chronic Opium Poisoning.—Chronic poisoning is, unfortunately, quite common, opium, usually in the form of laudanum or pills, being taken habitually by the mouth, or morphine by hypodermatic injection. The effects of the prolonged use of the drug, mental, moral and physical, are most deplorable. The symptoms however, are more or less indefinite, and some individuals appear to continue the habit for many years with comparative immunity and without detection. Usually the patient loses weight, becomes anæmic, and suffers from loss of appetite and indigestion. The bowels may be continuously constipated, or constipation may alternate with diarrhæa. The pupils are contracted, the skin and tongue dry, and the nails brittle, while the hair turns prematurely gray and falls out. The heart is apt to be irregular, and muscular tremors and unsteadiness of gait are often observed. The patient is nervous, lacking in energy and will-power, and entirely unfit for work of any kind. He is utterly untrustworthy in his statements, and becomes lost to all sense of honor and uprightness; lying in the

most barefaced manner and even committing theft, if necessary, in his endeavors to obtain the drug. Sexual impotence is a common result, and melancholia and dementia may eventually supervene, especially when morphine is used. In morphine *habitués* the arm, leg, or front of the body will usually be found to be scarred with marks of the needle. The craving for the drug is so intense that the patient suffers agonies when temporarily deprived of it, and it becomes necessary for him to increase the dose from time to time in order to secure the desired effect. The daily quantity of morphine used is thus often exceedingly large. The practice of opium smoking, the method of employment in vogue among Oriental peoples, appears to be less harmful in its results than the prolonged use of opium by the mouth or morphine by subcutaneous injection.

Treatment.—The treatment of chronic poisoning is attended with immense difficulties, especially on account of the degraded moral condition of the *habitué* and is very often unsuccessful in effecting a cure. As a rule, the patient should be isolated, and watched with the greatest vigilance to prevent his securing the drug surreptitiously. Elimination is essential but this does not mean violent purgation to the extent of setting up a toxic gastro-enteritis but the effects should be measured by the disappearance of the symptoms of addiction-toxæmia. The morphine must not be withdrawn suddenly, as this is likely to be attended by collapse and aggravated mental disturbance, but the dose should be gradually diminished until it is deemed judicious to stop it altogether. Inasmuch as the duration of the period of inhibition from the use of the drug is not proportionate to the dose it is important to lengthen the interval in order that interference with metabolism may not extend over so long a period of time. The withdrawal should be gradual because any reduction below the amount of body-need robs the addict of his more valuable asset in securing and maintaining recuperative powers. With improvement in his general condition gradual reduction to the point of discontinuance becomes comfortable and voluntary. Temporarily the patient, in some instances, may be made more comfortable by the use of atropine or scopolamine, administered cautiously. There is no known drug or combination of drugs which seems to have any specific or curative effect beyond their psychic influence, and the results of substituting agents, such as cocaine, for morphine have always proved disastrous. Superalimentation, massage, baths, and other general measures to improve the general condition are of great importance. No reliance can be placed upon any of the advertised cures for the morphine habit; most contain morphine and the remainder are useless. It is unfortunate that the victims of drug habits are so shamelessly exploited for gain, sometimes even under the guise of philanthropy, by both lay and professional charlatans. The patient on entering an institution for his cure must be most thoroughly and carefully searched so that the progress of cure can be accurately determined and that he shall not be possessed of a supply sufficient to keep him comfortable during his treatment.

Antagonism

Atropine.—Atropine (*see* p. 724) is an antidote to morphine, especially from the fact that it powerfully stimulates the respiratory center, and also because it tends

to antagonize the depressing effects of this drug upon the cerebrum and upon intestinal peristalsis. While appearing to be antagonistic in some other respects this is really not the case. Thus, although it arrests perspiration and dilates the pupil, it produces these effects by its action on the peripheral nerve terminations, while the opposite effects caused by morphine are due to action on the central nervous system. Still, it is found that in giving morphine by hypodermatic injection, certain of its disadvantages, such as indigestion, constipation and cardiac and respiratory depression may be prevented or rendered less marked by combining atropine sulphate (.0004 gm.; 1/150 gr.) with each dose.

HYDRATED CHLORAL

For the Preparations of Hydrated Chloral *see* p. 98.

Action of Hydrated Chloral

External.—Hydrated chloral, commonly but improperly known as chloral which is a liquid, has marked **antiseptic** properties. Locally, it is irritant, and at the same time **anæsthetic.** Applied to the unbroken skin in concentrated solution it causes redness and sometimes vesication. On denuded surfaces it has a decided corrosive action, and when injected subcutaneously is liable to excite considerable irritation.

Internal. *Alimentary Canal.*—Unless well diluted, it is irritant to the gastro-intestinal mucous membrane, and is therefore apt to occasion nausea, vomiting and purging. Absorption is moderately rapid from the alimentary tract.

Blood.—Hydrated chloral was first introduced as a hypnotic under the supposition that it was decomposed in the blood and chloroform liberated, but it is now known that it circulates unchanged, and the drug itself is present in the urine both in a free state and in combination with glycuronic acid.

Circulation.—Large amounts, by **depressing** the **vaso-motor center** in the medulla and by **direct action on the cardiac muscle,** have the effect of slowing and weakening the heart and of producing a fall of blood-pressure. It is thought probable also that the action of the drug on the muscular walls of the vessels has some influence in reducing the arterial tension. The same alterations in the action of the heart are produced as by chloroform, the auricular contractions becoming weak before the ventricular, and some dilatation occuring in both cavities. In fatal poisoning the heart is arrested in

diastole. In consequence of the vaso-motor paralysis, there results a marked dilatation of the cutaneous blood-vessels, and this may give rise to eruptions on the skin. Moderate doses usually have little effect on the pulse or blood-pressure, though these may possibly be transiently raised. Sometimes, however, even small amounts have a distinctly **depressing effect upon the heart.**

Respiration.—Under large doses the respiratory movements become more and more slow and shallow from the depressing action of the drug on the medullary center, which may be aided by the extreme weakness of the heart. In fatal instances, death usually occurs from **paralysis** of the **respiratory center,** though sometimes it is due to paralysis of the weakened heart. With moderate doses the respiration becomes slower and weaker, but scarcely more so than in natural sleep, in which the excitability of the respiratory center and the volume of the inspired air appear to be very much the same.

Central Nervous System.—Hydrated chloral is the **purest hypnotic** we possess. It has the effect of mildly depressing for a considerable period, and eventually completely paralyzing the central nervous system. Under its influence there is a successive depression, first of the brain, then of the spinal cord, and finally of the medulla oblongata. With small doses, therefore, it is often possible to confine the action of the drug entirely to the cerebrum, with the result of producing a sleep closely resembling the ordinary. Under somewhat larger quantities the sleep is more profound, and there is a depression of the spinal reflexes, while under still larger amounts the depression extends to the medullary centers, which are finally paralyzed. Hydrated chloral differs from morphine in apparently having no specific action on the sensory areas of the brain; so that acute pain is apt to prevent sleep after it. While a powerful hypnotic, it is not, therefore, an analgesic. It has also less influence on the sensibility of the skin than morphine, though very large doses cause anæsthesia. The **pupil** is always somewhat **contracted** under hydrated chloral. The irritability of the motor areas of the cerebral cortex is reduced by it, and they finally fail to respond to the strongest electrical stimulation. The spinal reflexes become paralyzed before the failure of the respiration. After the sleep caused by it the patient usually awakes refreshed, and free from headache or other disagreeable symptoms, though occasionally nausea and discomfort are felt.

Uterus.—It is believed to aid in the **relaxation of the cervix** but without lessening the uterine contractions of the first stage of labor.

Temperature.—Hydrated chloral causes a considerable reduction in the temperature, and this is largely due to the diminished heat production from the lessened muscular activity. Another factor, no doubt, is the increased output from the dilatation of the cutaneous vessels, and it is possible also that the irritability of the heat-regulating centers in the brain may be diminished.

Skin.—Hydrated chloral *habituês* often present peculiar purplish blotches upon the face, while erythema and urticaria are not uncommon.

Metabolism.—There appears to be an increased destruction of proteids, with a more or less incomplete oxidation of waste products. The acidity of the urine is found to be much increased by the presence of urochloralic acid which is a combination of chloral and glycuronic acid, and the alterations in the metabolism are attributed to the excessive production of this acid in the tissues. It is to be noted also that less oxygen is absorbed and less carbon dioxde given off in consequence of the lessened muscular movement.

Excretion.—It is excreted mainly by the kidneys as such and more largely as urochloralic acid. Part of it, however, is excreted into the stomach, and to this circumstance may possibly be due, it is thought, the gastric irritation which, as mentioned, is in some instances experienced on awaking from the sleep caused by hydrated chloral.

Therapeutics of Hydrated Chloral

External.—Hydrated chloral is used to some extent as a rubefacient and counter-irritant, as well as an antiseptic. As a dressing for suppurating wounds, cancer of the uterus, foul ulcers, etc., it may be applied in a solution of 2 per cent. strength, and for bromidrosis or hyperidrosis in solutions of from 2 to 5 per cent. Hydrated chloral solutions, about 1 to 20, may be used for parasitic skin diseases, such as tinea and are employed to allay itching in eczema and prurigo. As a local anodyne and counter-irritant in neuralgia, pleurodynia, lumbago or other painful affections; an excellent preparation is composed of equal parts of hydrated chloral, camphor and menthol, triturated together to form a liquid. This is also effective when rubbed into the legs to relieve painful cramps in the calves of the legs.

Internal.—Hydrated chloral has the advantage of being a promptly acting and certain **hypnotic,** for the relief of insomnia from over-work or worry, from the excitement of fever, or after various excesses, particularly alcoholic or sexual, but is **far from being safe.** It depresses the heart and respiration so markedly that the physician should be always upon his guard. It does not relieve the distress and cough of disease of the heart and lungs, and must naturally be given, if at all, with special caution when these organs are affected. It sometimes may be of use in arteriosclerosis or in chronic nephritis if the blood-pressure be high. It had better be avoided for the most part, whenever stomach or bowel troubles are present, as it is very liable to increase the irritation of these parts. In the insomnia of fevers it is often of great service in the early stages, but as the disease progresses, the weakness of the heart may contra-indicate its use. It is of no value in producing sleep in patients in whom insomnia is due to pain from any cause. It has been used as a cerebral depressant in puerperal convulsions, delirium tremens, and mania, but very large doses are usually required, and the effects of the drug must be watched with great care. It has caused sudden death in alcoholics with fatty heart. In threatened delirium tremens, however, sleep may sometimes be induced by quite moderate doses in association with potassium, or better, sodium bromide. It is of special value in sleeplessness from mental over-work, worry, etc., and in other forms of nervous insomnia. A very important use of hydrated chloral is in midwifery; here it has been designated the **medicinal forceps.** Frequently after rest has been obtained by this drug labor proceeds vigorously and is rapidly terminated. It has been employed with more or less success in incontinence of urine, tetanus, and poisoning by strychnine and physostigmine. If on account of spasm the patient is unable to swallow, it may be administered by the rectum. It is especially indicated in tetanus and strychnine poisoning because it depresses the motor tract of the spinal cord. It is a safer remedy for children than for adults, and is often prescribed for infantile convulsions, chorea, laryngismus stridulus, whooping-cough, and other spasmodic affections. It sometimes acts very happily in controlling or alleviating the paroxysms of whooping-cough. Hydrated chloral is of considerable value in seasickness, and may sometimes be efficacious in the morning sickness of pregnancy, especially when there is dizziness, faintness, and repugnance to food,

with but little vomiting. Should the odor of the drug tend to excite nausea, it may be given by the rectum and administered in this way has been advised for other forms of nausea and vomiting of reflex origin, such as occur in uterine fibroids and various other conditions. A favorite vehicle for the administration of hydrated chloral is syrup of tolu, and its unpleasant taste can be concealed by giving it in bottled "lemon soda."

Hydrated chloral is to be avoided in circulatory failure, uræmia or pneumonia with failure of respiration and in acute nephritis, and acute gastritis, especially in alcoholics.

TOXICOLOGY

Acute Poisoning.—The symptoms of poisoning, as might naturally be supposed from the physiological action of the drug, closely resemble those of opium. Thus, there is profound coma, with weak and slow respiration and pulse but not so marked as in morphine poisoning, and lividity of the surface. There is complete muscular relaxation, the reflexes are abolished, and the pupils contracted. The temperature is depressed, and the skin cold and clammy. The action of the heart is irregular as well as weak, and before death may become rapid. The pulse should always be carefully watched whenever hydrated chloral has been administered. It frequently happens that symptoms of failing heart come on unexpectedly even after small doses.

Treatment.—The stomach should be evacuated by the stomach tube. Emetics (*see* p. 380) may be employed, but are of less value on account of the depressing action of the drug on the medullary centers. Artificial warmth must be supplied by means of hot bottles and blankets, and the temperature maintained also by friction and massage. Somnolence is to be resisted by injecting strong coffee into the rectum and by such measures as flagellation, douches, flapping with wet towels, and shouting at the patient. On account of the cardiac depression, the patient should not be forced to take active exercise, such as brisk walking. The inhalation of amyl nitrite may be employed to stimulate the heart, and strychnine or caffeine subcutaneously injected to relieve the respiration. Artificial respiration may also be called for.

Chronic Poisoning.—The "chloral" habit is very easily acquired by persons who have continuously used the drug in ordinary doses for even a short time for the relief of insomnia or other purpose, and, once established, it produces serious results and is very difficult to break. The patient suffers from digestive disturbances, marked physical and mental weakness, with sudden flushings due to vaso-motor derangement, from palpitation of the heart, and from quite significant erythematous eruptions, generally of a purplish color, especially upon the face. In some instances there are bed-sores, ulcerations and sloughs. Dyspnœa, dependent upon the cardiac and respiratory depression and the general cachexia, is a prominent symptom. Sleep can be secured only by the accustomed hypnotic, and an overdose may at any time result in collapse and death, since by reason of

the cumulative effects of the poison in the system the vital functions are greatly impaired and elimination may be rendered impossible. It is to be noted also that the sudden withdrawal of the drug may lead to symptoms resembling those of delirium tremens, and as fatty degeneration of the heart is likely to be present, such a development is sometimes attended with the gravest danger.

Treatment.—The drug must be slowly withdrawn, alkalies in large quantities being administered during the process. Good and easily digested food in which the carbohydrates predominate with hygienic rules of life are of great importance.

SULPHONMETHANE

For the Preparations of Sulphonmethane *see* p. 101.

Action of Sulphonmethane

Sulphonmethane, while a less efficient **hypnotic** than hydrated chloral, is also less dangerous, as it has no depressing cardiac action. It does not affect the heart directly, though it may cause a slight quickening of the pulse through its depressant effect upon the inhibitory center. Through its action on the central nervous system it also has some influence in **diminishing metabolism.** Its excretion is slower than its absorption, so that there is a cumulative action. This may lead to gastritis, renal disease, and certain changes in the blood which are not clearly understood. In consequence of the latter there is a characteristic discoloration of the urine, due to the presence in it of a reddish-brown pigment, hæmatoporphyrin, which is an iron-free product of the decomposition of hæmoglobin. This is found to occur chiefly in anæmic women, and is accompanied by constipation, vomiting and gastric pain, weakness and ataxia, confusion and partial paralysis, while eventually there may result suppression of the urine, collapse and death. Several fatal instances of poisoning by this drug have occurred from small doses continued for long periods. Sulphonmethane does not often lead to a habit, but instances are sometimes met with. Though its continued use may not induce the very grave results mentioned, it may be attended by severe functional disturbances. Persons taking it regularly for a considerable time are liable to suffer from multiple neuritis, muscular weakness, indigestion, impaired nutrition, and persistent cutaneous eruptions. The untoward effects of the drug can usually be avoided by intermitting its administration from time to time. It is thought to have some deleterious action on the heart when used for long periods, and

is found to be a much less certain hypnotic in cardiac disease than in other conditions. Very large quantities of sulphonmethane have been taken without fatal results, and in fact generally without any more serious consequences than prolonged unconsciousness; however, severe poisoning has occurred from its popular indiscriminate use, the symptoms being vomiting and diarrhœa, mental confusion with hallucinations, profound muscular weakening and incoördination, and finally collapse and death. An enormous single dose, however, has been known to cause paralysis of the sphincters, anuria, a fall of temperature, and, later, depression of respiration. The drug is largely decomposed in the body, and excreted in the urine as ethylsulphonic acid, but a small portion escapes unchanged. Sulphonmethane has little or no effect in relieving pain.

Therapeutics of Sulphonmethane

Sulphonmethane is used exclusively to **produce sleep.** It is preferably administered in hot water, but on account of their convenient form, it is often given in wafers or tablets. These should be taken at least an hour to two hours and a half before the time when sleep is desired. As its absorption is very slow on account of its insolubility, sleep is somewhat late in following its administration, and not infrequently more or less drowsiness and depression are experienced the next day. It has also been employed for seasickness but the large dose required is likely to prove to be irritant to the stomach, and to the kidneys.

SULPHONETHYLMETHANE

For the Preparations of Sulphonethylmethane *see* p. 101.

Action and Therapeutics of Sulphonethylmethane

Sulphonethymethane is a **prompt hypnotic,** without marked cumulative action, and it has no injurious or unpleasant after-effects, save occasional dreams and nightmares, and rarely skin eruptions. Apparently the patients do not become habituated to its use.

As it is more soluble, **quickly absorbed** and active, it is generally preferred to sulphonmethane. It has been used as a hypnotic and sedative for the insane; for narcotic ***habitués,*** so far as is known, it is a

safe remedy. It is important that the daily action of the bowels be secured, an alkaline water be given daily, and weekly intermissions be insisted upon; otherwise it may give rise to disagreeable after-effects. It sometimes irritates the kidneys even to abolition of their function, but rarely produces hæmatoporphyrinuria. As is also the fact with sulphonmethane, multiple neuritis may follow the prolonged administration of small doses.

PARALDEHYDE

For the Preparations of Paraldehyde *see* p. 97.

Action of Paraldehyde

Paraldehyde is a prompt, powerful and safe **hypnotic.** The system is usually very tolerant of it, and it may be continued and found useful for long periods. It is quickly absorbed and produces sleep by **depressing the higher nervous centers** first; later it diminishes the reflexes, and finally there is a marked effect on the spinal cord. The anterior cornua are paralyzed, and there are abolition of reflex action, paralysis and anæsthesia. Fatal results from it are rare, but enormous quantities may cause death by paralyzing the respiratory center in the medulla. Its action on the heart is similar to that of sulphonmethane, causing a slight acceleration of the pulse by its depressant effect upon the inhibitory center. It often produces gastric irritation and an increased flow of urine. It is chiefly excreted by the kidneys, but in part also by the lungs, and the odor of the drug may be detected in the breath for some time after its hypnotic effect has passed off. An erythematous rash is sometimes caused, and its prolonged use may induce gastric catarrh, diarrhœa, and ulcers about the nose. Instances of the paraldehyde habit have been occasionally reported. There is great emaciation, cardiac weakness, unsteady gait, and mental confusion and agitation, with hallucinations of sight and hearing and unpleasant delusions. Restraint for several months is necessary for cure.

Therapeutics of Paraldehyde

Unlike hydrated chloral, paraldehyde may be given with **safety** in instances of cardiac disease. The principal objection to the drug is its

disagreeable and burning taste, and hence it is usually administered in capsules. If not given in this way, syrup and tincture of orange with water, so as to insure the dissolving of the paraldehyde, may be employed to conceal the taste, or the drug may be administered in glycerin (1 to 4), which renders it more palatable. The large dose required is also a disadvantage. If paraldehyde is to be of service, it usually produces **sleep** in thirty minutes, and this is **placid,** dreamless and **refreshing.** No lassitude or depression is experienced the following day, and the appetite often improves under its use. It is useful in most instances of simple sleeplessness, but is found to be of little service if there is any pain, or if there is cause for anxiety. To patients with gastric irritability and where there are convulsions it may be given by the rectum. Paraldehyde is principally used in institutions for the insane. It has been found valuable in all forms of mania, including the delirium due to alcohol or epilepsy. In instances of melancholia it may induce sleep, but is often disappointing. It is useful in mental excitement associated with chorea, and in many forms of senile excitement, with marked restlessness, it is an excellent remedy. It has a certain value in convulsive diseases, and has proved of service in some instances of epilepsy, chorea and strychnine poisoning. It sometimes relieves the symptom asthma and the paroxysms of whooping-cough, but on account of its disagreeable taste and pungent odor it is not well suited for children. It is said to have been efficacious in some patients suffering from polyuria. Poisonous doses result in depression of the medullary centers and cardiac paralysis.

ETHYL CARBAMATE

For the Preparations of Ethyl Carbamate *see* p. 102.

Action and Therapeutics of Ethyl Carbamate

Ethyl carbamate is a **mild hypnotic,** and is reputed to induce a calm, natural sleep without any disagreeable after-effects. As it is changed into urea in the body and excreted as such it is believed to be contra-indicated in nephritis. It is slightly diuretic.

In some instances it appears to act as an almost ideal hypnotic, but, unfortunately, there are many in which it has no effect. It is most successful in those in which there is no pain and where the sleep

is wanting rather from habit than from any uneasy feeling or from worry. It has been found beneficial in children and in sleeplessness following fevers or the result of alcoholic excess or of overwork; also in some instances where other more powerful drugs, such as hydrated chloral, have been taken for some time and where the patient feels that he must have sedatives to help him to sleep. It does not appear to be of much service among the insane.

HOPS

For the Preparations of Hops *see* p. 119.

Action and Therapeutics of Hops

Like other substances containing volatile oils, hops, to a slight extent, reflexly excite the circulation, and are carminative. The bitter principle likewise adds to the stomachic properties of the drug. Hops have an undoubted **sedative** and hypnotic influence, although it is not very marked, and appears to be subject to considerable variation.

Hops may sometimes be employed with advantage in hysteria, flatulent colic, and mild diarrhœas. A hop pillow is in vogue with the laity for promoting sleep; its only effect is probably a psychic one. In an extemporaneous infusion with tincture of capsicum they constitute an excellent substitute for alcoholic stimulants when it is desired to break off the use of the latter, and this combination is also very useful for the **wakefulness** and excitement preceding a threatened attack of delirium tremens.

LACTUCARIUM

For the Preparations of Lactucarium *see* p. 119.

Action and Therapeutics of Lactucarium

Lactucarium has been credited with mild hypnotic powers. Fresh lettuce is said to contain traces of hyoscyamine, but this is improbable, although since ancient times it has had the reputation of tending to induce slumber.

It is uite unreliable as a hypnotic, but in some instances appears

to have a quieting effect. The syrup is sometimes added to cough mixtures as a **sedative** especially for children, and has also been employed to allay nervous irritability and as an efficient substitute for the soothing syrups containing opium.

(3) **General anæsthetics.**

CHLOROFORM

For the Preparations of Chloroform *see* p. 98.

Action of Chloroform

External.—The local action of chloroform resembles that of alcohol, but is more energetic and more powerfully **antiseptic** and even in dilute solution will retard decomposition of urine. Chloroform is a protoplasmic poison of great intensity, and no living substance is capable of withstanding its lethal effect if exposed to its concentrated vapor for a sufficient time. Its evaporation on the skin has a **refrigerant** effect, and hence causes contraction of the blood-vessels and **anæsthesia** at the point of application. If, however, the vapor is confined, or if chloroform is rubbed into the skin, it has the effect of causing heat and redness, with dilatation of the local vessels; and the irritation may be sufficient to produce **vesication.** While, when locally applied, it is more irritant to mucous membranes than ether, yet when inhaled it is less irritant than the latter to the respiratory tract.

Internal. *Alimentary Tract.*—In the mouth it causes, in concentrated form, a burning sensation and pain, followed by anæsthesia, and increased secretion of saliva and mucous by reflex excitation of the glands. In the stomach and intestine it is also markedly **irritant,** often causing violent gastro-enteritis. In small doses its action is very much like that of the volatile oils, producing in the stomach a sense of warmth and comfort and inducing increased peristalsis. Absorption, it is believed, takes place more rapidly than is the fact with the volatile oils, and even when dilute in the blood it may produce degenerative changes in organs of the body. In the intestine it may perhaps have a slightly astringent effect.

Heart.—In small amounts there is a brief strengthening followed, very shortly, by **muscular weakness** and dilatation with small and

ineffective hearts; there may be considerable dilatation before there is a marked change in rate.

Arteries.—There is a brief period of rise in blood-pressure followed by a fall, probably due to depression of the vaso-constrictor center.

Respiration.—There is a short period of stimulation followed by a decided depression of the respiratory center. If the vapor is well diluted, it is soothing to the throat and bronchial mucous membrane so that cough and secretion may be lessened.

Blood.—Chloroform is absorbed into the blood from the gastro-intestinal tract, and, if administered by inhalation, from the lungs, and after absorption is thought to form a loose combination with the cholesterin and lecithin in the blood, perhaps in the red corpuscles.

Nervous System.—The effects of the drug, when inhaled, are commonly divided into three stages, which are not sharply defined, but are simply different degrees of the same action. For convenience they may be named the stimulant, the anæsthetic, and the paralytic.

First Stage.—There is a more or less marked preliminary feeling of asphyxia, but with this exception, the sensations are rather pleasant than otherwise. There is a sense of warmth experienced first about the face and head, but afterwards extending throughout the body, while the imagination is temporarily excited. The patient's comfort, however, may be disturbed by the local effects, such as smarting of the nose, throat and conjunctiva if the vapor be too concentrated, accompanied by an increased secretion of saliva, mucus and tears. Vomiting may possibly occur, but is rare at this period. The mind becomes confused from the irregular stimulation of the higher cerebral functions, but this stimulation is only evanescent, and the patient soon begins to lose consciousness. Hallucinations are apt to be present, and the special senses are disturbed, so that he experiences unusual sensations of light, and ringing, hissing and roaring in the ears. There is formication and a feeling of stiffness in the muscles and of inability to move the limbs. He loses his self-control, and gives way to manifestations which vary with his character—loud talking, laughing, singing, weeping, swearing, etc. The general sensibility becomes blunted, but is not abolished. With the depression of the higher functions comes on excitation of the lower motor functions, and the patient now often begins to struggle violently. He will kick, fight and throw his arms and legs about to

such an extent that it is difficult to restrain him. These motor phenomena vary greatly in different individuals, and in some instances, especially in children, are entirely absent. Occasionally, and particularly in hysterical subjects, convulsions are observed. In this stage usually the pupils are somewhat dilated, the skin warm and moist, the face flushed or cyanotic, the pulse accelerated, and the apex-beat augmented. The respiration is generally slightly quickened, but may be more or less irregular, at first in consequence of the sensation of asphyxia, and later from the struggling.

Second Stage.—The inhalation being maintained, the movements cease and the muscles become relaxed. In consequence of this relaxation, the face, which is now pale, assumes a calm appearance. The unstriped muscles are not usually affected, but there is sometimes a relaxation of the sphincters. There is paralysis of the motor reflex centers of the cord, as well as paralysis of the brain and depression of the medullary centers. Consciousness, sensation and most reflexes are abolished, and one of the last reflexes to disappear is the corneal. The pupils are contracted and do not respond to light, and the patient lies in a deep sleep. Snoring is apt to be produced from the falling back of the tongue into the throat. The respiration becomes regular, but slower and shallower than before the inhalation was commenced. The pulse is generally somewhat slow and weak, but regular, and the blood-pressure falls on account of the depression of the vaso-motor center. Vomiting is a frequent occurrence, and dilatation of the pupil and increased pallor are generally indications of its approach. The body temperature invariably sinks in consequence of the lessened muscular activity and to a less extent of the increased heat-loss, and in prolonged anæsthesia the fall may be as much as 3° to 5°C. (6° to 10°F.). When the inhalation is discontinued, the patient again passes through a stage of excitement, which is generally much less violent but may be more prolonged than before. Usually in recovering from the anæsthesia he falls into a sleep which lasts several hours, but not infrequently there are dizziness, nausea and vomiting for a considerable time.

Third Stage.—The characteristic feature of this stage, which must be carefully guarded against, is progressive paralysis of the medulla. The surface is cold and covered with a clammy sweat, and the pupils become widely dilated, though at the last they may be either dilated or contracted. The fæces and urine are often passed involuntarily.

The respiration grows irregular, stertorous and labored. The pulse, now also irregular, becomes more and more slow and feeble, the blood-pressure rapidly falls and the heart, weakened and dilated, is finally arrested in diastole.

There has been much discussion as to the cause of death in chloroform anæsthesia, and the Hyderabad Commission arrived at the conclusion that death is always due to arrest of the respiration. The criticism has been made that the alterations in the circulation produced by chloroform were not properly appreciated, or, at all events, were not sufficiently emphasized and it is now generally accepted that the fatal effect of chloroform, as seen in its use as an anæsthetic in surgery, is due chiefly and in most instances to its action upon the circulatory system, and especially upon the heart itself. In general the mode of administration really determines the manner of its lethal action. Thus, a percentage of chloroform vapor, so low as to be practically incapable of causing sudden death, will, if the administration is maintained, finally bring about a fatal result from over-narcosis, and under these circumstances it is almost invariably the fact that death is due to failure of the respiration from paralysis of the respiratory center in the medulla. Experiment has demonstrated that under the inhalation of very dilute chloroform the respiration always ceases several minutes before the heart, which continues to beat quite strongly a short time and then grows rapidly weaker, and that as the concentration of the vapor is increased, the interval between the failure of the respiration and of the heart becomes shorter. When air saturated with chloroform-vapor is inhaled, the interval between the two is so brief as to be inappreciable. The pulse, indeed, may be so weak as to be no longer perceptible before the respiration ceases, but if the movements of the heart be registered directly, it is usually found beating so long as the respiratory movements are carried on. From a practical point of view, it is of comparatively little importance whether there are a few fluttering beats of the heart after the last inspiration or not; the all-important question is whether the heart has been so injured as to be unable to carry on the circulation. Clinical experience has shown that it is the sudden administration of a high percentage of chloroform vapor which is responsible for most of the fatalities from this drug, and it is through its direct action on the heart that death is then caused. The cardiac muscle becomes paralyzed and more or less suddenly

fails to be effective in maintaining the circulation, so that the blood-pressure falls rapidly. The heart is now incapable of emptying itself, and, the organ becoming distended with blood, its muscle, after a few slight fibrillary contractions, confined to the ventricular bases, finally stops acting. The action of the respiratory system during this time must be regarded as for the most part secondary to the state of the circulation. When the blood-pressure has fallen considerably, the medullary centers become anæmic and the respiration fails. When the respiratory movements cease, the lesser, or pulmonary, circulation fails in consequence, and this embarrasses the heart still further, precipitating its distention and complete paralysis. Not only is the heart in a condition of paralytic distention, but the great vessels of the chest and abdomen are also distended with blood. In fact, the vaso-motor paralysis of the vessels in the splanchnic system must always be taken into consideration in determining the factors which bring about a fatal issue.

In its action on the central nervous system, as has been seen, chloroform affords an excellent illustration of the law of dissolution (*see* p. 682). Thus, the paralysis caused by it commences with the highest cerebral functions, those of self-control, and passes progressively downward through the lower intra-cranial divisions. The spinal cord is affected before the medullary centers, which are the last portions of the cerebrospinal axis to become paralyzed. In the recovery from chloroform also the law of dissolution is illustrated, the lowest functions, such as muscular tone, being the first to reappear. The muscles and nerves are not affected by chloroform when inhaled.

Metabolism.—A marked resemblance has been noted between the effects of chloroform on the metabolism and those of phosphorus, and in both conditions the **formation of acid** in excess in the tissues has been assigned as the cause of these effects. The preliminary administration of alkalies is sometimes advisable. After the administration of chloroform, either by inhalation or by the mouth, both nitrogen and sulphur elimination is considerably augmented; indicating, it is believed, an increased destruction of nitrogenous bodies in the tissues. The sugar of the blood has been found to be increased, and the glycogen of the liver diminished, or entirely absent, due to a specific action on the liver cells, which form glycogen into sugar much more rapidly than usual. **Fatty degeneration** of various organs, especially the liver, heart and kidneys, has been observed

after the repeated administration of chloroform, and even after a single inhalation, in some instances. If this attains a certain degree of development it is found that it may lead to failure of the heart, but otherwise the tissues recover in a few days. Atrophic cirrhosis of the liver has been produced by the drug when given in small quantities for several months. Similar but less marked effects have been observed in the kidneys, spleen and lungs, and they are regarded as the result of a preliminary fatty degeneration of the parenchymatous cells. In addition to its action on the central nervous system, it must therefore be recognized that chloroform produces marked changes in the processes of life and in the nutrition of the different organs.

Excretion.—Chloroform is excreted mainly by the lungs, but in small quantities may also escape in the urine, perspiration and milk. The urine sometimes contains glucose, acetone and, as is found in phosphorus poisoning, leucin and tyrosin. Some of the chloroform inhaled seems to undergo combustion in the body, and an increased acidity of the urine is attributed to hydrochloric acid formed by the combustion.

Therapeutics of Chloroform

External.—In severe **neuralgias** the deep injection of chloroform in the vicinity of the affected nerve is a valuable resource. The liniment, as a rubefacient, is employed to relieve the pain of neuralgia, myalgia and chronic rheumatism and to reduce chronic inflammations. Upon cotton it will often relieve the pain due to a carious tooth. Chloroform is also often used in liniments in association with camphor, tincture of aconite, or opium preparations. Chloroform is a good hæmostatic, and applied upon lint or absorbent cotton, may be used to arrest superficial bleeding. The solution of rubber in chloroform has been employed as a protective in small-pox and erysipelas, and has also been found useful in the treatment of fissured nipples, superficial burns, furuncles, psoriasis and herpes zoster. A lotion containing chloroform may be of service in urticaria. In irritable ulcer of the rectum and itching about the anus an ointment, such as that of zinc oxide, to which chloroform (1 to 8) is added, often affords great relief. Chloroform is an excellent antiseptic to preserve urine in transportation, 0.20 mil (3 ℥) to 120 mils (4 fl. oz.)

of urine is sufficient. The chloroform should be allowed to evaporate before testing the urine.

Internal.—As chloroform disguises the taste of many nauseous drugs, it is in common use for this purpose. The water is frequently employed as a vehicle and the spirit as a flavoring agent, and sometimes as a carminative. Like alcohol, the gastric effects of which are similar, chloroform is useful in some forms of dyspepsia, and in small doses it is sometimes given as a **cardiac stimulant.** Chloroform water, will often relieve vomiting when not due to inflammation of the stomach. Small doses of it, however, may prove of service for the vomiting and pain of gastric ulcer, especially when given in association with bismuth preparations. The spirit is used to arrest hiccough and also to relieve restlessness and irritating cough in pneumonia, pleurisy and bronchitis. A small quantity of it is a serviceable addition to expectorant mixtures when a neurotic element is present. The spirit, with an equal quantity of tincture of capsicum, in water, every half hour, has proved a valuable **hypnotic** in delirium tremens with symptoms of depression and adynamia. The spirit is also sometimes given with advantage, in combination with astringents and opium, in diarrhœa, and is considered especially useful in cholera morbus. In hysterical women the spirit is an excellent sedative to the nervous system.

Inhalation.—The inhalation of chloroform for **anæsthetic purposes** is principally employed for surgical operations, in biliary and renal colic, and in parturition. For painful delivery but a small quantity is required, as it is given, not to produce unconsciousness, but merely to blunt the sensibility, and it is a matter of common observation that chloroform inhalation is borne better by women in labor than by any other kind of subjects. Other purposes for which its inhalation is used are the relaxation of muscular spasm, as for the reduction of dislocations and herniæ, and to relax the muscles for diagnostic purposes, as for making a thorough examination of fracture or of the abdomen, for the detection of malingering, etc. Finally, it is used for the relaxation of spasm in the convulsions of eclampsia, tetanus, hydrophobia and other affections. In certain anæsthetic mixtures, which contain both ether and chloroform, the object is to obtain the anæsthetic effects of both these agents without the cardiac or respiratory depression of either. The present opinion in regard to these is that they present the disadvantages of both

the substances incorporated into them and the advantages of neither.

In the administration of chloroform **careful attention** must be paid to the following: (1) The anæsthetizer must be skilled, and give his attention exclusively to the production and maintenance of narcosis. (2) False teeth should be removed from the patient's mouth, to prevent the possibility of their falling into the throat and choking him. (3) No undigested food should be in the stomach; the patient should be fasting for at least four hours, if possible. If necessary wash out the stomach. If vomiting occurs, his head should be placed in such a position that no food can get into the larynx. (4) The clothing must be loose enough to allow perfect freedom of respiration. (5) The head should be a little raised and the lower jaw held up, in order to prevent the tongue from falling back over the larynx. (6) The chloroform must be pure; it must be transparent, colorless, neutral in reaction and not leave a residue on evaporation. (7) It should be given in such a way that the vapor may be thoroughly mixed with plenty of air; long or deep inspirations are inadvisable. (8) The administration must be gradual, as "pushing" the anæsthetic is dangerous. (9) The respiration should be watched with extreme care, as it appears to be a fact that gradual cardiac failure never takes place without producing respiratory changes from the first. A sudden cardiac arrest, as sometimes occurs in fatty heart, will not give warning either by the pulse or respiration. (10) The operation should never be commenced until the stage of muscular relaxation has set in, when reflex action is to a large extent abolished. From neglect of this precaution many lives have been lost, the heart being reflexly stopped by the stimulus of the knife; and it is a fact that most of the deaths from chloroform have occurred during slight operations, in consequence of the mistaken notion that because an operation is trivial it may be begun early. The eye-reflexes should be under constant observation. (11) In operations about the mouth care must be taken to prevent the entrance of blood into the air-passages; it is not a proper anæsthetic for removal of the adenoids or tonsils. (12) The anæsthetic must be administered with special care in the old and in all patients where pulmonary disease is present or where the heart is feeble from any cause. It is contra-indicated in fatty heart. (13) Special care is also called for when the operation necessitates awkward positions, and particularly those, such

as the lateral position, in which the respiration is more or less interfered with. The sitting posture is not suitable for chloroform anæsthesia. (14) In consequence of the reduction of temperature caused by chloroform, the warmth of the patient must be attended to. (15) Chloroform should never be administered without a hypodermatic syringe, in good order, being at hand. Amyl nitrite, ether and ammonia should be in readiness. (16) Inasmuch as substances irritating to the lungs, such as carbonyl chloride or even free chlorine, may be produced when the vapor of chloroform comes into contact with a naked flame, in the presence of which chloroform is decomposed, good ventilation should be insisted upon when gas light must be employed. It should be remembered that while the toxic effects of chloroform may show themselves suddenly yet they may be delayed for several days. (17) Chloroform is not entirely free from danger in obstetrical patients; feeble uterine contractions and an inaudible fœtal heart are contra-indications. (18) It should always be remembered that from satisfactory anæsthesia to toxic manifestations there is but a very short distance and a brief time.

Should any signs of respiratory failure occur, artificial respiration must at once be commenced, the tongue being pulled forward by forceps to facilitate the ingress of air. The most efficient means of performing artificial respiration is the use of the Hoyt pump, each full stroke of the piston of which forces into the lungs, through an intubation tube inserted in the larynx, an amount of air corresponding with the normal inspiration. Other measures which may be employed are the flicking of the face and abdomen with wet towels, the administration of amyl nitrite by inhalation, and the hypodermatic injection of strychnine or ether. Camphor, by hypodermatic injection, may be useful if the heart is predominately affected. Brandy, or alcohol in any other form, should not be given. Galvanization over the cardiac area has been recommended, but it is probable that this is harmful rather than beneficial. The heart may be stimulated by large rectal injections of hot normal saline solution, or of hot decoction of coffee, if at hand. One of the most efficient means of maintaining or restoring the action of the heart and the respiration is the Maas process. This consists of the application of a series of compressions of the chest over the heart sufficiently forcible to create an artificial carotid pulse, the compressions being made at the rate of 120 per minute. The object in view is to create

an artificial circulation which may free the heart from distention and chloroformed blood, and raise the arterial tension so that the respiratory center may be supplied with blood. If symptoms of improvement do not appear at once, the patient should be inverted, and this procedure is facilitated by hooking the knees over the table. It is claimed by some that inversion only adds to the danger, but there is a considerable amount of clinical evidence going to show that it is of practical benefit, numerous instances being on record in which it was undoubtedly the means of saving the patient's life. The measures just mentioned should be maintained for hours, if necessary; but if in spite of them the heart utterly ceases to pulsate and the respiration completely fails, as a last resort the chest should be opened and cardiac massage practised by the Kemp-Gardner method, artificial respiration at the same time being maintained and the prolonged infusion of hot normal saline solution employed.

Chloroform may be chosen in hot climates; when a large number of persons are to be anæsthetized; in Bright's disease; in aneurism; in marked atheroma of blood-vessels; in children or adults who already have bronchitis; and in persons who struggle violently.

It is to be avoided in diabetes, sepsis, hæmorrhage, fatty degenerations, particularly of the heart, the lymphatic diathesis and in generally debilitated individuals.

The Committee of the British Medical Association, as to whether the ordinary methods of administering chloroform are trustworthy and safe, reached the conclusion that it is absolutely necessary to regulate the dosage of the drug, and that an apparatus is eminently desirable which will on the one hand permit the administration of a definite dose capable of securing anæsthesia and on the other not to endanger life. Furthermore, that safety depends upon dosage, that is, the proper percentage to be mixed with air. Concentration has been shown to be fatal, whereas it is maintained that a vapor below 2 per cent. is wholly safe, and that in most patients as low as 1 per cent. will maintain anæsthesia. A further step was to determine with scientific accuracy what the physical effects of various percentages were. Working with the isolated mammalian heart, it was found, that heart muscle takes up chloroform from fluid circulating in the coronary vessels and that its lethal effects very according to the fluid used. In diluted blood, for example, the chloroform gives less effect than in saline solution. With the increase of chloroform in the

circulating fluid, more is taken up by the heart muscle, until finally toxic effects result. With weaker doses an equilibrium appears to be established between the chloroform-containing fluid and the heart muscle, so that at last no further effect upon the muscle manifests itself, in spite of the continued flow of the chloroform fluid. It was found that under toxic doses the ventricle is paralyzed in its action before the auricle. The experiments show the extreme importance of restricting the dosage of chloroform to relatively weak percentages, and that the size of the dose circulating in the fluid through the heart is the important element, rather than the length of time during which it circulates. Higher concentrations than 2 per cent. should be looked upon as potentially dangerous, since their tendency is, other things being equal, to paralyze the heart muscle. The prolongation of the anæsthesia with a dilution under this percentage is not to be regarded as dangerous although naturally individual susceptibility must be taken into account, and, as usual, arguments drawn from animals cannot be, forthwith and without modification, applied to man. It will be observed that these experiments in a measure controvert the idea that chloroform has a cumulative effect upon the heart. As they were made upon the isolated heart, they would appear to leave unassailed the position that the use of low percentages, if continued sufficiently long, may bring about a fatal result by inducing paralysis of the respiratory center.

BROMOFORM

For the Preparations of Bromoform *see* p. 99.

Action and Therapeutics of Bromoform

Bromoform, an analogue of chloroform, is **anæsthetic** and antispasmodic, and also has antiseptic properties. When inhaled, the narcosis produced by it is shorter than that of ether or chloroform.

It has been employed internally in influenza and spasmodic cough, and especially in **whooping cough.** In the latter it is a remedy of value, but must be employed with great caution, as poisoning from its use has been reported. As a rule, it is better in this affection to depend upon agents attended with less danger. On account of its high specific gravity it is likely to separate from mixtures unless very carefully compounded.

ETHER

For the Preparations of Ether *see* p. 102.

Action of Ether

External.—By its rapid evaporation when applied to the skin, ether produces a sensation of cold, and the part becomes **blanched** from the resulting contraction of the blood-vessels. When it is used in the form of a spray, this action is intensified, and marked **local anæsthesia** is caused. If, however, evaporation is prevented, or friction used, an irritant effect is produced, though less pronounced than in the case of alcohol or chloroform.

Internal.—In the mouth and stomach its effects are similar to those of alcohol and chloroform. It is a very prompt **carminative,** causing increased secretion of the glands and dilatation of the gastric vessels. By **reflex action** it also at once **stimulates the heart,** increasing the force and frequency of the pulse and raising the blood-pressure, and at the same time it excites respiration. It is absorbed rapidly and is not only a quickly acting **diffusible stimulant,** but also an **antispasmodic.**

Nervous System.—The action on the central nervous system in general resembles that of chloroform, but in some important particulars when given for **anæsthetic** purposes there is a difference. They differ as follows: (1) Chloroform acts 36 to 48 times as powerfully as ether in paralyzing the heart. The pulse is not nearly so much affected by ether as by chloroform; while it may be somewhat slower than usual, it is full and strong. (2) Chloroform is three to three and one-half times more depressant than ether to the medullary centers and to the rest of the central nervous system. (3) Anæsthesia is produced with greater difficulty, more slowly, and often less thoroughly with ether than with chloroform; consequently, the stage of excitement is usually more marked and prolonged, and naturally attended with more struggling. (4) It is necessary to give the ether in much more concentrated form in order to produce narcosis—about 70 per cent. of ethereal vapor to 30 per cent. of air. (5) Consequently, it is much more difficult to administer than chloroform. (6) Also it produces more irritation of the respiratory passages. (7) Ether is much more likely to irritate the kidneys. (8) Chloro-

form is much more agreeable to inhale. Its odor and taste are sweet and pleasant, and it causes less irritation and less feeling of suffocation. (9) Ether is eliminated more slowly, and the odor therefore lingers about the person for some time. (10) On account of its inflammability, ether is dangerous in the vicinity of an exposed flame or where the actual cautery is to be used. When artificial light, other than the incandescent electric, must be employed, the lamp should always be adjusted above the patient, since the vapor of ether is heavier than air.

Kidneys.—From experimental researches it appears that ether-anæsthesia may have, for some unexplained reason, a specific action upon the kidney, consisting of a constriction of the arterioles of the organ. This is entirely independent of any change in the general arterial circulation, since it is found, from the carotid tracings taken in the laboratory, that the blood-pressure is raised from the beginning. The vascular contraction in the kidney has a damaging effect upon the renal secretory cells, similar to that which follows clamping the renal artery; the kidney shrinks in bulk, and as the etherization progresses to deep narcosis there is a diminished secretion of urine, marked albuminuria, hæmaturia, and, finally, suppression. It would seem probable that in man a corresponding action is elicited.

Excretion.—So far as known, ether appears to be excreted only by the lungs.

Therapeutics of Ether

External.—An ether spray may be used in superficial neuralgia, where the benumbing of the nerve sometimes effects a permanent cure. It is also employed at times to produce **local anæsthesia,** by the cold resulting from the evaporation of the drug, for small operations, and it is particularly useful where thoracentesis or paracentesis abdominis is to be performed, or a simple incision made. As a rule, however, the hardness of the tissues caused by it is a serious objection as regards operations, while the subsequent reaction is liable to produce considerable tingling and pain, as well as oozing of blood from the wound. Where such local anæsthesia is used, the cold produced should not be intense enough to actually freeze the tissues, as this renders the healing slow. Since it dissolves fat from the skin, ether may also be employed as a detergent before

operations, the part to be operated on being washed with it after soap has been used. Ether being a good solvent of the active principles of many drugs and also of sebaceous matter, it has been strongly recommended as a menstruum for various remedies to be applied to the skin. The spray has sometimes been successfully used in strangulated hernia, and its application to the spine has been followed by good results in chorea.

Internal. *Stomach.*—Ether is very useful in colic and some forms of dyspepsia. Small doses of the spirit (Hoffmann's drops) which may be administered in camphor water, are efficient in expelling flatus from the stomach and are often of service in gastralgia and sick headache. A few drops of ether, added to cod liver oil, will render it more tolerable to the stomach and facilitate its digestion and absorption, probably by increasing the secretion of pancreatic juice.

Heart.—On account of the rapidity of its action, ether is a **cardiac stimulant** of great value, and it is frequently employed in fainting, palpitation and heart-failure. It may be given either by the mouth or by hypodermatic injection. It is also a useful **anti-spasmodic** in asthmatic attacks.

Inhalation.—Ether is administered as a **general anæsthetic** for the same purposes as chloroform. On account of its greater safety, it is more commonly used in the United States. Some accidents with chloroform are not doubt due to carelessness, on account of the great facility with which it can be administered, but granting this, there can be no question that chloroform is the more dangerous agent of the two. From the statistics it would appear that the immediate mortality with chloroform is from three to five times as great as with ether. The difference in the concentration required to produce anæsthesia and that which will cause serious impairment of the heart's action, or which will stop the respiration, is very much smaller in the case of the one than of the other. Hence the preference should be given to ether except when this is specifically contra-indicated, as in bronchitis, pulmonary inflammations, nephritis, or in old age when it might cause the rupture of a degenerated artery in the brain. From clinical observation, as well as from experimental research above cited, it is clear that ether has a special tendency to produce kidney disturbance, and as a rule, therefore, it had better be avoided when renal disease is present, and particularly when

with this there is a tendency to pulmonary œdema. If employed at all, it should be administered with the greatest caution to those suffering from the various forms of acute or chronic kidney disease, or renal insufficiency from any cause. Both ether and chloroform have been shown to be highly dangerous in instances of diabetes. Much attention has of late been directed to fatalities occurring as sequelæ or surgical anæsthesia: in chloroform more surely and particularly in consequence of fatty degeneration of the heart and kidneys or of diabetic coma, and in that of ether from uræmia and from bronchitis, pneumonia and pulmonary œdema, especially in the subjects of nephritis. In a considerable number of instances death from pulmonary œdema with bronchial effusion and aspiration-pneumonia has occurred in the course of a few days after etherization. It is claimed that these post-anæsthesia deaths are decidedly more frequent after ether than after chloroform, and, in fact, that their number is large enough to bring the total mortality from ether, immediate and secondary, quite up to or even beyond that of chloroform. Some surgeons, it may be stated, who formerly used ether almost exclusively, believing that if a fair estimate were made the fatal uræmias and pneumonias depending on ether, if properly credited to it, would reverse the record as it stands at present, are now employing chloroform. As it is very difficult, however, to distinguish between the results of the anæsthetic and the ordinary forms of disease, no very reliable statistics are as yet available in regard to the point at issue.

In using ether it should be remembered that, while it has a greater latitude of safety than has chloroform, this latitude should not be abused. While ether gives warning of approaching danger and is comparatively safe, its administration should never, by choice, be entrusted to a novice. The practice is now quite common of commencing ether-anæsthesia with the preliminary inhalation of nitrous oxide gas, and in this way the disagreeable results of the administration of ether to the patient may be largely obviated and a more rapid and satisfactory narcosis secured.

Or there may be a preliminary anæsthesia with chloroform, particularly for the obese, alcoholics or athletes. Often a preliminary administration of morphine and scopolamine, hypodermatically, will act as a general sedative to the mind and body, and, of more importance, it will lessen shock. Atropine will stimulate the respiratory center, lessen bronchial secretions and prevent early vagus stimula-

tion, but it interferes with the expected reactions of the pupil and so may mislead. Preliminary administration of carbohydrates and water, giving sufficient time so that the stomach shall be empty at the time of the operation, obviates nausea and fatty degeneration of the tissue. In addition post-operative acidosis can be prevented by administering by the rectum 15 gm. (4 dr.) of sodium bicarbonate in solution.

For the nausea and vomiting sometimes caused by ether and persisting after its administration, sodium bromide has been recommended.

Although ether generally has been employed by inhalation, and doubtless will continue to be, other methods have been advocated. Colonic anæsthesia, with ether and olive oil, at present, has some advocates. The bowel is previously cleansed with an enema of sodium bicarbonate in solution or of normal salt solution. The preliminary injection, one hour before operation, consists of .008 gm. (⅛ gr.) of morphine sulphate, 4 mils. (1 fl. dr.) of paraldehyde with 14 mils. (3½ fl. dr.) of ether and the same amount of olive oil. The ether 180 mils. (6 fl. oz.) with 60 mils. (2 fl. oz.) of olive oil, is administered twenty minutes before the operation with a special apparatus, free escape of the vapor being essential. This method avoids the disturbances of the early stages of anæsthesia, especially the respiratory, lessens shock and post-anæsthetic nausea and vomiting and is theoretically indicated for operations about the head and neck and in acute inflammations of the respiratory tract. It obviates any post-operative colon bacillus infection which is fairly frequent. However, this method has been followed, by diarrhœa, hæmorrhage from the bowel, and in one instance, rupture of the colon.

No matter what anæsthetic is employed, its selection is as important as its administration, and it is one's duty to use the safest under the particular conditions at hand. One should not expect an uneventful anæsthesia in alcoholics, addicts to tobacco, athletes, persons subject to car- or sea-sickness, and generally in neurotics. Percentages of strength and the amount of the anæsthetic used are important but the condition of the patient is paramount and that respiration and especially its depth is to be closely watched. The experience of the anæsthetist is more important than either anæsthetic or inhaler. It should always be remembered that it is easier to add

to, than subtract from, the effects of the anæsthetic and therefore to use only the necessary and safe amount, and above all, that it is possible for a patient to die as the result of an anæsthetic.

NITROGEN MONOXIDE

For the Preparation of Nitrogen Monoxide *see* p. 38.

Action of Nitrogen Monoxide

The inhalation of this gas produces unconsciousness in from one to three minutes which is sometimes preceded by erotic or pugnacious excitement. The gas has a direct action upon the nerve centers in the brain, chiefly upon the cerebrum. It but slightly affects the spinal cord, for the conjunctival reflexes persist even in deep anæsthesia, nor the motor nerve-trunks. It has no definite influence upon the heart or circulation nor does it form any compound with hæmoglobin. Its anæsthetic action is from its direct action upon the nerve centers with the addition of that resulting from asphyxia.

Therapeutics of Nitrogen Monoxide

It is the safest of all known anæsthetics; even at any age. Whatever deleterious effects may occasionally show themselves are not due to the presence of poison but to the absence of oxygen and immediate artificial respiration is the one remedy for these effects. The difficulty in its use is the brief duration of the anæsthesia. The symptoms of asphyxia are immediately overcome by the inhalation of oxygen and avoided by its contemporaneous use. It is sometimes administered as a preliminary to ether-anæsthesia. For all that it is safe, nitrous monoxide anæsthesia is not altogether satisfactory to the operator. Slight cyanosis is not an alarming symptom; jactitation signifies that more oxygen should be given. The bladder, especially in children, should be emptied before administration. Good anæsthesia is not to be expected with alcoholics. Since many suits have been instituted, based upon the sexual hallucinations during anæsthesia, a third person should always be present during it.

DIVISION XI.—DRUGS ACTING ON THE ORGANS OF GENERATION

A. Aphrodisiacs.—These are substances which increase sexual desire and power. They are supposed to act by stimulating, directly or reflexly, either the cerebral or spinal genital center. The latter has been located in the lumbar portion of the cord, and irritation of it induces erection. It is conceivable that it may be excited by afferent impulses conveyed to it from various parts of the body, but especially from the cerebrum and the genital organs. Its activity appears to be largely dependent upon the condition of the general health, and hence tonics and all measures promoting the bodily nutrition may act as indirect aphrodisiacs.

The following drugs are known as aphrodisiacs; their mode of action in this regard is not very clearly understood.

(1) **Strychnine.**	(3) **Alcohol.**	(5) **Camphor.**
(2) **Cantharides.**	(4) **Cannabis.**	(6) **Phosphorus.**

Strychnine probably acts by raising the tone of the spinal centers, cantharides and camphor through reflex irritation from the urethral mucous membrane, alcohol and cannabis by their effect on the imagination, and phosphorus by improving the general condition, especially in chronic nervous exhaustion.

B. Anaphrodisiacs.—These are remedies employed to diminish sexual desire. They are supposed to act by decreasing the local circulation, by lessening the excitability of the nerves of the genital organs, or by depressing the genital centers. Most of them, it may be said, are probably effective by diminishing or removing some source of irritation which is reflexly producing an aphrodisiac effect.

Drugs used as anaphrodisiacs are—

(1) **Bromides.**	(4) **Belladonna.**	(7) **Digitalis.**
(2) **Iodides.**	(5) **Hyoscyamus.**	(8) **Purgatives.**
(3) **Opium.**	(6) **Stramonium.**	

Local applications of ice, or cold baths, are sometimes of service as anaphrodisiacs.

C. Ecbolics or **Oxytocics** are remedies which during or immediately after parturition increase uterine action.

They are—

(1) **Ergot.**
(2) **Hydrastis.**
(3) **Dessiccated Hypophysis.**
(4) **Cotarnine.**
(5) **Quinine.**

Ergot is by far the most important. Occasionally some of these drugs will act upon the gravid uterus to initiate abortion, and most of them have been used with varying results for this purpose with criminal intent. Powerful purgatives may increase uterine action and should be used with care during pregnancy.

D. Emmenagogues are substances used to increase the menstrual flow. Diminution of the menstrual flow is a symptom of a large number of conditions; so that the various drugs which are beneficial in any of these are indirect emmenagogues. Certain substances in addition to the ecbolics, however, appear to have a special action in increasing the amount of the menstrual flow.

They are—

(1) **Petroselinum.**
(2) **Manganese salts.**
(3) **Asafetida.**
(4) **Myrrh.**
(5) **Guaïac.**
(6) **Cantharides.**
(7) **Cimicifuga.**
(8) **Sodium borate.**
(9) **Purgatives.**

Among the many indirect emmenagogues those more commonly used are iron, cod liver oil, and strychnine, which act by improving the general health. Hot foot- or hip-baths, especially if mustard be added, often aid the onset of menstruation.

E. Drugs which Depress Uterine Action.—These are employed to diminish or abolish the contractions of the gravid uterus.

They are—

(1) **Viburnum prunifolium.**
(2) **Bromides.**
(3) **Opium.**
(4) **Hydrated chloral.**
(5) **Cannabis.**
(6) **Chloroform.**
(7) **Antimony and potassium tartrate.**

F. Drugs Acting on the Secretion of Milk.

Galactagogues.—These are drugs which increase the secretion of milk. The most prominent are:

(1) **Pilocarpus** and (2) **Alcohol.**

Of these pilocarpus is the most powerful, but its effects soon pass off. Alcohol has but a feeble effect, although the malt liquors have considerable reputation as galactagogues. The secretion is very dependent on the general condition of the system; so that the best means of securing an abundant flow of milk is to maintain the general health.

Antigalactagogues.—These are drugs which decrease the secretion of milk.

Belladonna, either applied locally or given internally, is usually efficient for this purpose, by paralyzing the nerves of the mammary gland.

The following *drugs* are *excreted by the milk,* and are therefore ingested by the nursing child:—Oil of anise, oil of turpentine, oil of copaiba, and most volatile oils, sulphur, rhubarb, senna, jalap, scammony, castor oil, opium, iodine, antimony, arsenic, bismuth, iron, lead, mercury, zinc salts, and potassium iodide. It is evident, therefore, that these remedies must be administered with care to the mother; for example, copaiba or turpentine will make the milk so unpleasant that the child will not take it. Such of the above list as are purgatives, when given to the mother, may cause diarrhœa in the child. Opium should not be given in large doses to the mother. On the other hand, mercury, arsenic, and potassium iodide may be administered to the child by being given to her.

The Aphrodisiacs

PHOSPHORUS

For the Preparations of Phosphorus *see* p. 42.

Action of Phosphorus

Phosphorus has a **specific action on bones,** and especially those of young animals which are still growing. Under the influence of minute quantities the marrow becomes hyperæmic and the leukoblastic tissues increase, the growth of bone is favored and the cancellous tissue tends to become compact, and there is a deposition of bone of normal composition. This effect is attributed to the phosphorus acting as stimulant to the bone-forming cells, and arsenic also appears to produce it to some extent. Small doses of phosphorus generally increase the number of red blood-corpuscles in man. Unless taken in a state of fine division or dissolved in oil, it is absorbed with difficulty, because of its insolubility in the fluids of the body and of its slow volatilization. The great mass of it, if finely divided, is absorbed unchanged and exists in the blood as phosphorus, and its action is due to this element rather than to its compounds. But little is known of its fate in the body. It is thought that a portion may perhaps be oxidized to phosphoric acid, and some of it is stated to be eliminated by the lungs, while some is excreted in the urine in obscure organic combinations. Phosphorus diminishes tissue waste, decreasing the elimination of urea and of carbon dioxide. As it is found to be a **necessary element in the nervous system, its** action is that of a stimulant to its growth.

Therapeutics of Phosphorus

Phosphorus is especially indicated in osteomalacia, in rickets, and in instances of ununited fracture. Without doubt it promotes calcareous deposit in the **healing of fractures.** It is of value in convalescence from exhausting diseases, in **nervous exhaustion,** in neuralgia when dependent upon debility, in alcoholism, in sexual exhaustion, and in various suppurative affections.

TOXICOLOGY

Acute Poisoning.—As phosphorus is quite accessible in the form of matches or vermin-paste, poisoning by it, either accidental or suicidal, is not uncommon.

Symptoms.—For some hours no effect is observed. Then there is a burning pain in the abdomen, with nausea. The vomit, as well as the breath, has the characteristic garlic-like odor of phosphorus and it becomes luminous if heated with sulphuric acid. There is general depression, and this may amount to fatal collapse. Usually, however, the patient recovers from these effects and appears to be quite well for two, three or four days, when he again begins to suffer from vomiting, and the vomited matter is often bloody. There are also abdominal pain, distention and tenderness, and sometimes diarrhœa, and the stools may contain blood. With these symptoms there occurs jaundice, which soon becomes very marked, and the area of liver dullness is increased in consequence of fatty changes occasioned by that organ. The emesis, abdominal pain and diarrhœa are explained by the same cause, the epithelial cells of the stomach and intestine undergoing fatty degeneration. There is considerable muscular weakness and pain, together with a small and quick pulse and general prostration. Slight fever is sometimes observed, but the temperature is often lowered in the later stages, though the patient usually complains of intense thirst. Hæmorrhages may occur in many different situations, and the immediate cause of these is fatty degeneration of the muscular coat of the smaller arteries throughout the body. The urine also may contain blood, as well as bile, leucin and tyrosin crystals, albumin, and an abnormal amount of ammonia. Peptone is sometimes excreted, and the phosphates and sulphates are apt to be increased from the augmented tissue-waste. The chlorides are much diminished, in consequence of the patients taking little or no food. Sarcolactic acid, regarded as diagnostic of phosphorus poisoning, appears in considerable quantity in the urine, and is sometimes accompanied by glucose. The condition described lasts from five to eight days, when the patient usually dies of heart failure, as a result of fatty degeneration of the cardiac muscle from the direct action of the poison upon it. Towards the last, convulsions and coma may occur, and these are regarded as a result of disordered metabolism, rather than due to any direct influence on the central nervous system. Even when the symptoms are very severe, however, recovery is possible. With phosphorus burns, however, none of the symptoms of phosphorus poisoning are presented.

Post-mortem.—Widely extended fatty degeneration is a prominent feature of the post-mortem findings, and in this respect phosphorus resembles arsenic,

antimony and chloroform. This pathological change is most marked in the liver, but numerous fat globules are observed in the cells of many other organs, notably of the kidneys and the gastric and intestinal glands, and also in the muscle fibers of the heart, stomach, intestines, smaller arteries, and often of the skeletal muscles. As to whether this fat is formed by the degeneration of the protoplasm of the cells in which it is found, or whether it is carried from other parts of the body and simply deposited in these cells, is as yet undetermined, but the evidence appears to be directly in favor of the latter view. Another characteristic feature is the appearance of numerous hæmorrhages and ecchymoses. In addition to the fatty degeneration of the muscular coats of the arteries referred to, it is probable that the absence of clotting in the blood, due to changes in the intestine and liver, which interfere with the formation of fibrin, is a factor in the causation of these. It has been noted that if the patient lives long enough, there may be a diminution in the size of the liver, and altogether the symptoms of phosphorus poisoning present a considerable resemblance to those of acute yellow atrophy of this organ.

Treatment.—As phosphorus is absorbed from the alimentary canal comparatively slowly, an attempt should be made in the early stages to remove it by emetics or the washing out of the stomach and by purges. Afterwards the object is to oxidize the phosphorus. Laboratory experiments have shown that old (ozonized) oil of turpentine, which contains oxygen, if administered before the poison is absorbed, is an antidote. Ordinary oil of turpentine, however, is worse than useless, for as phosphorus is soluble in oils, its absorption is simply aided by giving any oily or fatty substances. Repeated and free inhalations of oxygen have been used, and this suggests that hydrogen dioxide may be efficacious when given by the mouth. Potassium permanganate has also been advised for the purpose of oxidizing the phosphorus. In the secondary stage alkalies are recommended in order to neutralize the excess of sarcolactic acid formed in the tissues.

Chronic Poisoning.—From the fact that the red or non-poisonous phosphorus is now generally employed in match factories, chronic poisoning, which was formerly frequently met with in those who worked among phosphorus fumes, has become of rare occurrence. Such poisoning manifests itself in gastro-intestinal irritation and a peculiar necrosis of the jaw, "phossy jaw." The latter, which usually has its starting-point in carious teeth, begins with salivation and suppurative ulceration of the gums; after which there results an extensive periostitis, involving the whole jaw. The lower jaw is more often affected. Phosphorus necrosis must be treated surgically on the same principles as other necroses. The diseased bone readily becomes the seat of tuberculous deposit, and sufferers from phosphorus necrosis not infrequently die from general tuberculosis.

THE HYPOPHOSPHITES AND THE GLYCEROPHOSPHATES

For the Preparations of the Hypophosphites and the Glycerophosphates *see* p. 42.

Action of the Hypophosphites and the Glycerophosphates

The hypophosphites are believed to exert some special influence on nutrition. Practically the whole of the hypophosphite administered

can be recovered from the urine, showing that they are not oxidized to phosphates in the tissues, as was formerly believed and it may be that they have no further action than the other indifferent salts, such as the chlorides.

The administration of the glycerophosphates has been found to increase the amount of urine, and notably the urea, the carbon dioxide and sulphur oxidation co-efficient, the chlorides, sulphates, lime, magnesia and potash, with but little effect on uric acid. They seem to improve the **nutrition** and more particularly that of the nervous system.

THERAPEUTICS OF THE HYPOPHOSPHITES AND GLYCEROPHOSPHATES

Notwithstanding the unsatisfactory experimental evidence of their value, the hypophosphites are extensively used in **cachectic conditions,** especially tuberculosis, and are the basis of a large number of proprietary preparations. They should be of chemical purity, neutral in reaction; the presence of free alkali or alkaline carbonates quickly giving rise to an atonic dyspepsia. In the early stages of phthisis (infiltration) the sodium salt should be administered and the sodium salt alone; if excavation is present the calcium salt is indicated, and this alone, provided that it does not suddenly check expectoration; when the sodium salt should be resumed. The potassium salt is a valuable **expectorant** in chronic bronchitis; but it has a very limited usefulness in phthisis. The hypophosphites, when administered intelligently, apparently relieve some of the symptoms of this disease. If administered in too large doses, or simultaneously with other remedies, as arsenic, stimulants, strychnine, or cod-liver oil, they are likely to produce headaches and indigestion and fail to cause improvement. The objection to the official syrup, namely, the use of the salts in combination, applies to nearly all of the proprietary preparations, with the addition that most of the latter contain impure salts, as well as a low percentage of hypophosphites, and are not scientific combinations.

Inasmuch as the urine of neurasthenics contains relatively large amounts of incompletely oxidized phosphorus, especially in the form of glycerophosphoric acid, the effort was made to replace this loss by the introduction of phosphorus into the organism in a form approaching, as nearly as possible, that in which it exists in the nervous system. The indication for the use of the glycerophos-

phates is **nerve depression.** They are useful in various neuralgias, as sciatica, tic douloureux, in Addison's disease, and in the symptom-complex, known as **neurasthenia.** Chlorosis, albuminuria and phosphaturia have been benefited. In diabetes some improvement in the general condition and diminution of the amount of sugar excreted have been noted. The remedies should not be expected to rejuvenate senility, but are useful adjuncts, even if slowly acting, to the systemic treatment of diseases of the nervous system.

The Ecbolics

ERGOT

For the Preparations of Ergot *see* p. 176.

Action of Ergot

External.—Upon the skin ergot has no appreciable action, but upon mucous membranes, when injected hypodermatically, it has somewhat of an **astringent** and **hæmostatic** effect.

Internal. *Gastro-intestinal Tract.*—Digestion is much impaired in consequence of the disturbance caused in the circulation; nausea and vomiting is common; the alkaloids are not irritant. **Increased peristalsis** is induced after a preliminary stimulation of the ends of splanchnic (inhibitory) nerves of the intestine, and paralysis with diarrhœa frequently results. The intestinal vessels are constricted, partly in consequence of the contraction of their own muscular coats and in part from that of the muscular fibers of the bowel.

Circulation.—The effect of ergot on the circulation is the combined effect of the alkaloids and of the saponins which it contains and the latter may produce a fall of blood-pressure. The active principles intravenously cause a high blood-pressure which is indicated by a hard and small pulse, which is usually also slow. The **rise in blood-pressure** may for a time be concealed by the slowness of the heart, but it is always **very marked,** and is one of the characteristic effects. It is dependent upon a **general contraction of the arteries,** which appears to be due to a slight extent to action on the vaso-motor centers but largely to direct action on the muscular coats of the vessels or on the terminations of the vaso-motor nerves in muscles. Because it constricts the arterioles ergot is **hæmostatic.** Very large doses may paralyze the vaso-motor centers, with the effect of causing a fall of blood-pressure from vascular dilatation and cardiac depres-

sion. If ergot is taken continuously for a considerable time **gangrene** in various situations, as the ears, tip of the nose, fingers or toes, or ulcerations of any area of the skin, or of the stomach, or even gangrene of the lung or uterus, is apt to result from the vascular contraction and stasis of the blood stream, with coagulation and hyaline thrombosis. This is a prominent feature of chronic poisoning, which is known as **ergotism**, and it was frequently met with in former times among the lower classes of Europe, who, after poor harvests especially, were obliged to use flour contaminated with ergot.

Nervous System.—Besides the gangrenous form of chronic ergot poisoning, the other principal form is the **convulsive.** The differences in the several varieties of ergotism are explained by the different actions of the constituents of the drug and by the fact that they may act partly on the blood-vessels and in part directly on the central nervous system, either from spasm of the arteries or from degenerations of nerve cells from obliteration of the arteries. In some epidemics both the gangrenous and convulsive forms have been present, but, as a rule, one has been much more prevalent than the other. In convulsive or **spasmodic ergotism** there are at first formication, itching and tingling of the surface, followed by numbness and local anæsthesia. Not infrequently anæsthesia and hyperæsthesia are found at the same time in different parts, or even in the same part. These manifestations commence in the hands and feet, and then spread over the whole body. This disturbance of sensation even affects the alimentary canal, so that there may be present at once both voracious hunger and loss of appetite. At the same time there are much weakness and depression, often with severe headache and giddiness, as well as central disturbances of the special senses, such as dimness of vision and impairment of the hearing. There may follow **convulsions,** usually clonic in character and often epileptiform, and contractures in the limbs and sometimes in the trunk muscles may result. In earlier times, the disease was immediately fatal in a large proportion of instances and when recovery took place it was apt to be followed by more or less loss of intellectual power, and in some instances by complete dementia.

Uterus.—One of the most prominent features of the action of ergot is its property of exciting **contractions in the pregnant uterus.** Whether the ecbolic effects of ergot are due entirely to its action on

the terminations of the hypogastric nerves in the muscular wall of the uterus itself, or on the central nervous system or on both, is still unsettled but with probabilities largely in favor of the former theory. Its action upon the unimpregnated uterus appears to be of the same kind, but much less marked in degree, and of very infrequent occurrence; in fact its action has been denied. Furthermore in some instances of ergotism, pregnancy has gone on without interruption. In labor moderate doses of ergot increase the strength of the normal contractions while large doses may set up a tetanic spasm in the uterine muscles.

The saliva, perspiration, urine and milk are diminished by ergot, and this is supposed to be due to the **general vascular contraction** caused by it.

Therapeutics of Ergot

Ergot is chiefly used for the purpose of insuring **tonic contraction of the uterus after parturition,** and thus guard against the occurrence of post-partum hæmorrhage. If severe hæmorrhage is threatened, it is advisable, in order to obtain a more prompt effect, to administer it hypodermatically. The modern practice is to forbid the use of ergot until after the expulsion of the placenta. The only possible exception to this restriction is during the second stage of labor in instances where it may seem to be indicated as a prophylactic against post-partum hæmorrhage. Even under these circumstances it should never be given if there be the slightest mechanical obstacle to delivery, of if the fœtal head be high up in the pelvic canal. If the remedy is made use of at this period of labor, it is essential that the fœtal heart should be carefully watched, so that in threatening asphyxia, instrumental delivery may be promptly resorted to. One objection to the use of ergot before delivery is that the uterine contractions induced by it are likely to become more and more severe and prolonged, so that ultimately the continued pressure may endanger the life of the child, while if serious mechanical obstruction is present, even rupture of the uterus may be caused. If employed before the membranes have ruptured, it may prevent the further dilatation of the os uteri and, through the constriction of the uterine muscle, deprive the fœtus of its blood supply. When given at the time of the passage of the child's head it is likely to produce its effect prematurely, and thus give rise to hour-glass contraction and

interfere with the expulsion of the placenta. It is also used to check menorrhagia in which it often does by producing contraction of the uterine muscle and thus diminishing the hæmorrhage. Later it may be used to procure complete involution of the uterus and avoid the unpleasant results of subinvolution. It is sometimes beneficial in uterine fibroids, aside from its checking hæmorrhage, and good results have been obtained from its long-continued use in congestive dysmenorrhœa, amenorrhœa dependent on plethora, and in chronic metritis, especially of the form resulting from subinvolution.

Ergot enjoys reputation as an **internal hæmostatic,** and in addition to uterine hæmorrhage, it has been employed in epistaxis, hæmoptysis, hæmatemesis and renal and intestinal hæmorrhage. While some regard it with much favor, it is certainly by no means uniformly successful, and the marked increase of blood-pressure which it causes may prove objectionable. The special indication for its use in hæmorrhage is regarded as a want of tonicity of the vessels, and in this condition the alkaloïds should be employed. Where an especially prompt effect is required it should be administered subcutaneously, and this method is often preferable in hæmatemesis on account of the irritability of the stomach. By its action in slowing the heart and causing such contraction of the arterioles as to induce a marked increase of blood-pressure, the coagulation of the blood in an aneurismal sac is promoted. In **small aneurisms** of the peripheral main arterial trunks it is thought possible that it may effect a cure by means of the contraction resulting from its direct action on the unstriped muscular fibers in the affected portion of the vessel. It is also recommended in miliary aneurisms of the intra-cranial arterioles, giving rise to such symptoms as vertigo, epistaxis, headache and *tinnitus aurium;* likewise when there is a sluggish and partially obstructed state of the intra-cranial veins, usually due to chronic arteritis and accompanied by hebetude, dizziness, epistaxis, etc. In certain forms of mental disease, such as recurrent mania, chronic mania with lucid intervals, and epileptic mania, when associated with cerebral hyperæmia, ergot has been found useful. Much success is also claimed for it, when given in large doses, in **congestion of the spinal cord** and meninges and in acute myelitis, as well as in the congestive form of migraine. Its hypodermatic use in cerebro-spinal menginitis is highly recommended by some writers, and in the epidemic variety of this disease it is claimed as one of the remedies from which the best results are

to be expected. Ergot has enjoyed considerable reputation in the treatment of diabetes insipidus, nocturnal enuresis, and in delirium tremens. Other conditions in which it has proved of service are incontinence of urine caused by a paretic or paralytic state of the bladder sphincter, distention of the bowels after abdominal operations, and some forms of spermatorrhœa.

TOXICOLOGY

Acute Poisoning.—This is generally the result of its use an an abortifacient. Nausea, vomiting with diarrhœa and abdominal pain are evidences of the gastro-enteritis which it causes. In addition there may be anæsthesia of the skin or hyperæsthesia with tingling and itching, mental depression, and convulsions followed by collapse and coma. *Treatment.*—This should be directed entirely toward relief of the gastro-enteritis and the collapse.

Chronic Poisoning.—The symptoms of both the gangrenous and the convulsive forms have already been described (*see* p. 796).

HYDRASTIS

For the Preparations of Hydrastis *see* p. 177.

Action of Hydrastis

Hydrastis, administered before meals is a **simple bitter.** In moderate doses it promotes appetite and digestion, and by central action increases the gastro-intestinal secretions and motility, the **flow of bile** and intestinal peristalsis. Its general action is due principally to its alkaloid, hydrastine. This primarily stimulates the centers of the medulla oblongata, causing slowing of the heart, increased arterial tension, and a quickening of the respiration. The **rise in blood-pressure** is due to **constriction of the arterioles.** Under larger amounts there is a stimulation of the spinal cord, similar to that produced by strychnine, causing clonic convulsions, followed by tonic convulsions and tetanus. Furthermore, it weakens and paralyzes muscle, an action which is confined to the heart and consequently the blood-pressure falls, and eventually both the medulla and cord are paralyzed, death occurring from **failure of the respiration.** The constriction of the arterioles is not due, apparently, to any direct action on the walls of the vessels, but rather to the stimulation of the vaso-motor center.

Respiration.—Generally the respiratory center is stimulated; it is depressed by toxic doses so that death results from asphyxia resulting from paralysis of the respiratory center or produced by the convulsions.

Eye.—Locally applied a solution of the alkaloid at first produces myosis but later mydriasis.

Uterus.—It increases the normal contraction of the uterus, but is less useful in the post-partum period. As it acts on both muscle and blood-vessels it is often more efficient than ergot in arresting **uterine hæmorrhage.**

Hydrastinine has been found to cause a much greater constriction of the peripheral vessels, as well as less depression of the heart, than hydrastine. It is also stated to differ from the latter in producing no marked disturbance of the centers of motion except when given in the enormous doses, which paralyze the nervous system.

Therapeutics of Hydrastis

External.—Hydrastis is much used empirically for subacute and chronic inflammations of the mucous membranes, the benefit derived from it being due in great measure to the contraction of dilated blood-vessels. The various preparations diluted with water, may be employed as injections in gonorrhœa, vaginitis, leucorrhœa, otorrhœa, and nasal catarrh, and as lotions for syphilitic mouth-lesions, mercurial or aphthous stomatitis, follicular pharyngitis, fissured nipples, hyperidrosis, acne, seborrhœa, and various other conditions.

Internal.—Hydrastis is useful in **gastric catarrh,** especially when induced by chronic alcoholism, and often proves of service in intestinal indigestion. In chronic catarrh of the intestine, even when ulceration has occurred, it may prove of great service, and it is especially esteemed in duodenal catarrh accompanied by catarrh of the gall-ducts and jaundice. It is employed to a large extent in uterine disorders such as menorrhagia and dysmenorrhœa, and also to check the growth of uterine tumors, because it not only increases contraction of the uterine muscle as does ergot but in addition produces vaso-contraction. For the arrest of **hæmorrhage,** hydrastinine hydrochloride is to be preferred, but while this is valuable in other uterine hæmorrhages, it has little effect in post-partum hæmorrhage. On account of its marked action in constricting the arterioles in general, hydrastinine hydrochloride should prove of service in hæmorrhages other than uterine, but here the effect is largely negatived by the rise of general blood-pressure. As an **antiperiodic,** hydrastine, while much inferior, is ranked by some writers as next in value to quinine. In chronic malarial cachexia it may be given with iron preparations.

COTARNINE HYDROCHLORIDE

For the Preparation of Cotarnine Hydrochloride *see* p. 118.

Action and Therapeutics of Cotarnine Hydrochloride

Cotarnine hydrochloride acts upon the myocardium as does hydrastine but upon the uterus it is **hæmostatic** in the same way as hydrastinine. Since it is a local hæmostatic, it has been applied upon absorbent cotton, chiefly for small hæmorrhages. Its chief use internally is in the treatment of congestive and especially hæmorrhagic conditions of the uterus such as menorrhagia. In hæmoptysis and possibly other internal hæmorrhages it may be given hypodermatically. In threatened abortion, since it is not markedly ecbolic, it may be used in small doses to check hæmorrhage.

The Emmenagogues

CIMICIFUGA

For the Preparations of Cimicifuga *see* p. 179.

Action and Therapeutics of Cimicifuga

Cimicifuga is to some extent a cardiac stimulant, slowing the action of the heart, and increasing its force, but its action in this respect is not important. In large doses it depresses the heart and vaso-motor system. Cimicifuga is generally believed to **cause uterine contractions.**

It has been employed for many years in a great variety of conditions dyspepsia, fatty and irritable heart, dysmenorrhœa, **amenorrhœa,** subinvolution, neuralgia, and especially chorea. That it is of very much benefit beyond that accomplished by a **simple bitter** is open to question. It has been asserted that it sometimes promptly cures urticaria of nervous origin after the failure of other treatment.

PARSLEY FRUIT

For the Preparations of Parsley Fruit *see* p. 179.

Action and Therapeutics of Parsley Fruit

In large doses it acts as a cerebral and circulatory stimulant, very similar to coffee and has a special action upon the **uterine circulation.**

In large doses it may cause vertigo, tinnitus and severe frontal headache suggesting cinchonism.

Its most important use is in the treatment of amenorrhœa, given twice or three times daily for the week preceding the expected date of menstruation; so soon as symptoms of menstruation appear the remedy should be given every three or four hours until the flow is well established. It is particularly useful when there is **inactivity of the ovaries** which requires a direct emmenagogue. It will often increase the flow of a scanty menstruation and occasionally relieve the pain accompanying the molimen.

PRECIPITATED MANGANESE DIOXIDE

For the Preparation of Precipitated Manganese Dioxide *see* p. 88.

Action and Therapeutics of Precipitated Manganese Dioxide

When given by the mouth it exercises an effect only in so far as it is dissolved in the secretions. In large amounts it causes gastro-intestinal irritation, and in smaller doses has some astringent action. Only a very minute quantity is absorbed from the alimentary canal. When given by subcutaneous injection it may give rise to epileptiform convulsions. This substance is thought by many to have a specific influence upon the uterus.

It has been used empirically as an **emmenagogue** and is probably a reasonably certain agent of the kind when administered in maximum dose.

Drugs which Depress Uterine Action

VIBURNUM PRUNIFOLIUM

For the Preparations of Viburnum Prunifolium *see* p. 180.

Action and Therapeutics of Viburnum Prunifolium

Viburnum prunifolium is believed to be an **antispasmodic**; it seems to lessen the motor functions of the spinal cord, depress the heart and lower the blood-pressure.

It is extensively used in the nervous diseases of pregnancy and undoubtedly has given good results in the effort to **prevent miscarriage**, especially if it is habitual. It has considerable reputation as a remedy for spasmodic dysmenorrhœa, in the treatment of after-pains, and in menorrhagia, particularly during the climacteric. This remedy has been in use for many years as a sedative in dysmenorrhœa and is undoubtedly of value.

DIVISION XII.—THE SERUMS

Serums have been classed among alterative remedies, and with a certain amount of reason; but their manner of action and the methods by which they are administered are different from those of ordinary alteratives. To the class of substances, of an albuminous nature, produced in the animal organism by pathogenic germs, which is deleterious to the animals themselves the name **toxin** has been given, while to a different class of substances, also albuminous and also produced by the same germs, but which is inimical to the bacteria, the name **antitoxin** has been assigned. The toxin acts both as a local and systemic poison, and by its hostile influence upon the bacteria the antitoxin tends to counteract both of these effects. The precise *modus operandi* is as yet unknown, but it is thought probable that the antitoxin affects the protoplasm in such a way as to render it capable of resisting the action of the toxin. It is to be noted, however, that the antitoxin has been demonstrated not to be a germicide for the pathogenic organism; so that there is still considerable mystery as to just how it produces the beneficial effects observed from it.

Those official are—(1) **Antidiphtheric Serum.** (2) **Antitetanic Serum.**

Antidiphtheric serum is also known as **diphtheria antitoxin.**

Serums, other than antitoxins or nutrient serums, are attenuated cultures made from pathogenic germs, and often called **vaccines,** the administration of which is designed to confer immunity against the special disease caused by the germs from which the cultures are made.

ANTIDIPHTHERIC SERUM

For the Preparations of Antidiphtheric Serum *see* p. 252.

Action of Antidiphtheric Serum

In addition to the production of toxins, albumins and an organic acid, the bacillus of diphtheria, as it develops in the body, induces the formation in the blood of a substance, known as an antitoxin which is **antidotal** to the toxin of the bacillus. It is largely due to this substance that organisms can resist the disease.

Antidiphtheric serum has a favorable effect upon all the symptoms of **diphtheria** and also a marked influence in preventing the occurrence of sudden heart-failure which constitutes one of the great dangers of the disease. The temperature, however, is less affected than the

other symptoms. Statistics afford overwhelming evidence as to the value of antitoxin in reducing the mortality from diphtheria. They also show that the frequency of laryngeal diphtheria is diminished by its use, and that the mortality of patients upon whom intubation or tracheotomy has been practised is likewise diminished. Furthermore, the time during which the tube must be worn is decreased. After the serum has been employed, it is found that although the bacilli continue to be present, the formation of membranous exudation ceases, and that which is already present rapidly disappears. Consequently, if antitoxin be used early, the membrane rarely extends from the fauces into the larynx. It is not until twenty-four hours after injection, however, that the maximum effect of the antitoxin is observed. It is stated that the frequency of the occurrence of post-diphtheritic paralysis is not diminished, although the percentage of recoveries in patients with paralysis is slightly increased.

The use of the antitoxin is sometimes attended with untoward effects, but as a rule these are of very little importance. That they are not due to the antitoxin itself but to something else in the serum, seems to be shown by the fact that they may result from the injection of an alien serum. Inasmuch as the antitoxic substance is combined or associated with the globulins it is now possible to administer a much smaller dose but possessing the same antitoxic strength. The most common of these effects is a rash, usually erythematous in character, but sometimes resembling measles or urticaria, and another is pain with swelling in the joints. Somewhat rarely there have been observed an irregular temperature range and, consecutively, emaciation and death; evidently pointing toward an acquired septicæmia. Further, in a few instances an early fatal result has been reported. It has been shown that in a fatal issue nephritis is the cause of death in a majority of instances, and clinically hæmorrhagic nephritis is by no means rare.

Therapeutics of Antidiphtheric Serum

As the mortality from the disease when antitoxin is used increases in proportion to the lateness of its employment, it is evident that the administration should be commenced at the earliest possible moment. It is the safest plan to give antitoxin on a clinical diagnosis, without waiting for a bacteriological culture. Inasmuch as this remedy militates solely against the infection of the Klebs-Loeffler

bacillus and clinically most instances of diphtheria are those of mixed infection, the usual local antiseptic and general supporting measures must not be omitted. The danger of antitoxin lies in the horse-serum, for, many years before antitoxin was made, the results of injection of an alien serum had been pointed out. Concentrated serums then should be preferred in that they give the largest amount of antitoxin with the smallest amount of serum. In instances of moderate severity it is recommended that a dose of 10,000 units should be given at once. A second injection may not be required, but if the symptoms demand it, the dose should be repeated two or three times at intervals of twelve hours. In severe instances, or in those treated late, the dose should be 10,000 to 20,000 units. If no amelioration of the condition is observed within two or three days, the further continuance of the treatment appears to be useless. The injections are usually made, with a specially devised syringe, between the shoulders or on the side of the abdomen, and should be given under strict aseptic precautions.

So far as prophylaxis is concerned, the question is practically settled that after 1,000 units have been injected it is rare that diphtheria develops. This immunity is believed to last for at least three weeks. Some failures have been reported, and, even instances of re-infection have occurred after antitoxin has been used during a previous attack. Owing to the development of anaphylaxis there is danger of producing untoward symptoms if antitoxin is administered several days after the patient has received an immunizing or curative dose. The dried serum does not lose its potency and should be employed when it is impossible to obtain supplies of recent manufacture.

Antidiphtheric serum has also been employed with some success in the treatment of asthma, enteric fever and epidemic cerebrospinal meningitis on the theory that it increases leucocytosis and favors the elimination of poisons.

ANTITETANIC SERUM

For the Preparations of Antitetanic Serum *see* p. 254.

Action of Antitetanic Serum

The toxin of the tetanus bacillus has a selective affinity for nerve tissue and for that reason the symptoms, as convulsions, result from changes brought about in nerve centers. The serum, however,

having no such affinity can only neutralize such toxins as still remain in the circulation. While the serum has decided antitoxic, it has no antibacterial properties.

Therapeutics of Antitetanic Serum

In view of the extreme gravity of tetanus, in acute and rapidly developing instances of the disease, it is advisable to employ the serum at the earliest possible moment, and repeat the injections as frequently as may be necessary. The serum may be injected intra-durally, the skull having been previously trephined, or intra-spinally and this if often preferable. The dried antitetanic serum is sometimes applied locally to a wound, especially a lacerated one, after it has been thoroughly cleansed by irrigation with normal saline solution. This serum is to be preferred when it must be kept for some time before using. In the event of any injury in which there appears to be likelihood of the development of tetanus, as in certain localities notorious for its prevalence or in wars conducted in highly cultivated regions, the prophylactic use of serum is not only advisable but imperative.

DIVISION XIII.—THE VACCINES

VACCINE VIRUS

For the Preparation of Vaccine Virus *see* p. 255.

Action of Vaccine Virus

Proper vaccination and revaccination, in localities where it has been thoroughly and systematically employed, has practically stamped out small-pox. The method employed is the attenuation of the virulence of the causative organisms of small-pox by its passage through an animal of greater resistance to the disease than man and is known as Jennerisation, thus giving proper credit to Edward Jenner, who, in 1796, discovered and proved its efficacy. With the present obligatory methods of preparation there is no danger of transmitting any disease peculiar either to man or the bovine species.

THERAPEUTICS OF VACCINE VIRUS

Vaccination at the time of infection of small-pox may modify the disease since the incubation period of vaccinia is four days, while that of variola is twelve days.

Vaccination is best performed by **scarification** with a fine needle previously sterilized in a flame. The preferable site is over the insertion of the deltoid in males and the upper and outer portion of the leg in females. The site is thoroughly washed with soap and water with friction to remove any epidermis which is infected with bacteria. If mercury bichloride in solution is used as a germicide it must be thoroughly washed off with hot water to avoid destroying the activity of the vaccine virus. Three or more scratches 3 mm. (⅛ in.) apart and 8 mm. (⅓ in.) long are made and the virus is thoroughly rubbed in with a sterilized wooden tooth pick or small glass tube. No dressing, or one of cotton kept in place with adhesive plaster, is required. It may also be employed hypodermatically with probably less reaction. The virus must not come into contact with anything liable to infect it from the time that it leaves the sterile container until it is applied to the scarifications. If there is much local irritation, sterile zinc oxide may be dusted upon it; if there is excessive redness itching or burning a solution of phenol, 1 to 125, in water, may be applied as a lotion.

Vaccination at the age of four months and one week as practised in England is unnecessarily early; it should, however, be performed during the first year. **Revaccination** on reaching the school age and again about the eighteenth year virtually protects the individual against small-pox for life. Revaccination of properly protected individuals, during the imminence of an epidemic among unvaccinated individuals is a matter of precaution not of necessity.

Antivariolous vaccination has been followed by the cessation of an attack of pertussis and occasionally by improvement of gout, rheumatism and allied affections from which the patient may have been suffering.

DIVISION XIV.—THE ORGANIC EXTRACTS

The ductless glands of the body are probably more or less interchangeable in their functions; so that if one is unable to do its work, another assumes extra activity. It is a recognized fact that, in health, the blood is continuously supplied by certain glands with substances which are essential to the welfare of the system; so that a lack of these induces serious results. It has been demonstrated also that the untoward effects following the excision of the glands can be successfully obviated by the administration of the gland substance. The use of extracts of the glands of the body, known as animal or organic extracts, now has a legitimate place in medicine. They are usually active when given by the mouth, as well as by subcutaneous or intravenous injection, and thus present a marked contrast to the antitoxins, which, being proteid substances, are destroyed in the stomach. The chief object of the therapeutic employment of the organic extracts has hitherto been to supply a deficiency of the normal secretion, but as present their field of usefulness is becoming more extended, as their action becomes definitely understood and their practical value is demonstrated.

The official organic substances are:

(1) **Dried Thyroids.** (2) **Dried Suprarenals.** (3) **Desiccated Hypophysis.**

These substances might, with even better reason than the serums, be classified with the alteratives, but inasmuch as each has a definite, aside from a general, action they are properly considered separately.

DRIED THYROIDS

For the Preparation of Dried Thyroids *see* p. 250.

Action of Dried Thyroids

Circulation.—The thyroid gland is probably the main organ of the body to furnish substances producing **vaso-dilation,** and the administration of it has the effect of dilating the peripheral blood-vessels and reducing arterial tension. Consequently, the cutaneous surface becomes flushed and moist, and the cardiac action is more or less depressed. Unless its use is continued for a considerable time it has only a slight action on the heart muscle, but small doses increase and large doses diminish its force. The pulse-rate is quite constantly accelerated. Injections of dried thyroids into the circulation have

been found to cause a fall in blood-pressure of relatively short duration. The only effect of ordinary doses observed on the blood is an augmentation of lymphocytes.

Alimentary Canal.—Loss of appetite and diarrhœa are quite frequently caused by large amounts and occasionally by small doses.

Nervous System.—Dried thyroids is a **cerebral stimulant,** capable of causing wakefulness, acuteness and rapidity of thought, and general brain activity. Given to excess, it produces headache, nervousness, restlessness, insomnia, palpitation, hot flushes, sweating, increased irritability of the reflexes, tremors of the extremities, and even convulsions.

Kidneys.—The quantity of **urine** is uniformly **increased.** The effect has been thought by some to be due to some specific action on the kidney, or to the changes in the circulation, but it may possibly result simply from the augmented excretion of urea and other urinary elements. In some instances sugar is found in the urine.

Metabolism.—A greatly **increased oxidation** is induced, both nitrogenous and non-nitrogenous bodies being rapidly used up. On this account there is an increased excretion of urea, uric acid, and xanthin bases in the urine and of carbon dioxide by the lungs. It is found that the first effects are upon fat, the proteids not being acted upon until this has been reduced to a certain minimum. It is certain also that preparations of the thyroid gland which contain iodine in normal quantity increase the loss of proteids. These tissue changes result in a rise of temperature and a loss of body weight. The growth of bone in normal animals is increased.

Excretion.—The elimination of the active constituents of thyroids takes place, so far as known, entirely through the kidneys.

Therapeutics of Dried Thyroids

One of the constant and characteristic effects of removal of the thyroid gland is a **myxœdematous condition.** At an early period there is an abundance of mucin and later there occurs a marked hyperplasia of connective tissue, embryonic in character. The skin is hard, rough and dry, because there is no secretion, and the hair loses its vitality and falls out. Among the other changes observed are, abdominal vaso-dilatation, fatty and colloidal degeneration of the liver and kidneys, and hyaline degeneration of the arterial walls.

All of these phenomena may be made to disappear by thyroid feeding. It is also a well known fact that **atrophy of the thyroid glands** always accompanies myxœdema, and it has been found that if patients suffering from this affection are treated with thyroid gland, all the symptoms disappear, usually in about six weeks. For the treatment of myxœdema after the symptoms have all disappeared it will be necessary, in order to prevent a recurrence, that the patient should take small doses for the rest of his life. Goiter may sometimes be favorably affected by thyroid feeding, and especially the colloid variety. Complete disappearance is exceptional, but as a rule considerable decrease takes place, especially in the young. As recurrence is otherwise almost certain, the remedy must be continued indefinitely. In exophthalmic goiter it generally seems to be injurious, rather than beneficial. In **sporadic cretinism** excellent results are often obtained with it, and the brain symptoms share in the general improvement. It is useful, also, in cachexia strumipriva. Poorly developed young children are often benefited by it. In a few instances of imbecility in children, of tetany, and of climacteric insanity much improvement is reported to have been caused by it. Dried thyroids should be employed after thyroidectomy to prevent the symptoms which are likely to follow the operation; it may fail if the parathyroids have also been removed. In **hypothyroidism,** after partial removal of the thyroid gland and in the late stages of exophthalmic goiter with colloid degeneration, it is also indicated. Good results are also claimed in rickets, osteomalacia and in the delayed union of fractures. In instances of arteriosclerosis resulting in such disturbances from high tension as dizziness, sleeplessness and headache, dried thyroids have been found of marked benefit. It must be used with caution in persons suffering from organic disease of the heart. It has been observed in thyroid feeding for other purposes that not infrequently menorrhagia is produced, and it is asserted that in delayed menstruation, with or without anæmia, no drug is as efficient in causing normal menstruation as this. It has been given with success in chronic eczema and some other skin diseases, but the effects are by no means always permanent. This remedy has been advised and considerably employed in the treatment of obesity, but as it is not as efficient as some other means, and as its continued use in these patients is not unattended with danger, it is not to be commended.

Thyroidism.—A condition somewhat resembling exophthalmic goiter in its symptoms, though without exophthalmos or increase in the size of the thyroid, may be induced by over-doses. Very large doses taken for a long time are followed by marked sweating, febrile attacks, headache, general nervousness, tremors in face and extremities, and various paræsthesiæ and finally cause anæmia and emaciation and also produce tachycardia and ultimately degeneration of the cardiac muscle, so that permanent disability may result. The central nervous system is also depressed.

DRIED SUPRARENALS

For the Preparation of Dried Suprarenals *see* p. 251.

Action of Dried Suprarenals

External.—This has no effect upon the unbroken skin but in open wounds or upon mucous membranes it stimulates the vaso-constrictor nerve-endings of the arterioles at the site of application causing a blanching of the tissues and checking moderate hæmorrhage, if such exists.

Internal. *Circulation.*—There is little systemic effect when dried suprarenals are given by the mouth or applied to mucous membrane. Possibly by constricting the arteries it delays its own absorption. The principal action of suprarenal gland when given hypodermatically, is to increase the tone of all muscular tissue, mainly if not entirely by direct stimulant action, upon the sympathetic nerve endings or the point of junction of nerve and muscle, to **constrict** the **small arteries** especially in the splanchnic area, through its action on the vaso-motor center and the vaso-constrictor nerve endings and to **raise blood-pressure.** Its action on the circulation is thus exactly the opposite of thyroid. The rise in blood-pressure is immediate, but it is to be noted that this effect is very brief, and that it is elicited but feebly when the administration is by the stomach, owing to the rapid decomposition of the active principle. The pulse-rate is slowed from the reflex effect of increased blood-pressure and not from direct vagus stimulation. The cardiac stimulation is not produced for some time after the constriction of the vessels, and this explains most of the fatal instances in its use. Although this substance has produced sclerotic changes in the blood-vessels of animals there is not much likelihood of these changes being produced by therapeutic doses.

Respiration.—When given hypodermatically it produces marked relaxation of contracted bronchal muscles. In small quantities hypodermatically it increases the depth of respiration; if given intravenously it has the opposite effect and in addition the rate rises. There may be a depression of the respiratory center, which sometimes results in respiratory failure and death.

Alimentary System.—On intravenous injection the ends of splanchnic nerves are stimulated and thus gastric and intestinal peristalsis is inhibited. The mucus, saliva and bile are increased but the pancreatic fluid is diminished.

Muscle.—The contraction is not greatly affected but there is a marked slowing of relaxation, similar to that produced by veratrine.

Uterus.—There is a constriction of the uterine arteries and a contraction of the uterus.

Urine.—This is increased correspondingly with the rise in blood-pressure. Sugar is often found even if there is no rise of blood-pressure.

Certain unfavorable results have been noticed to be coincident with the local use of suprarenal solutions. These are stated to be: hæmorrhage, swelling and localized areas of œdema, retarded healing, sloughing, and unhealthy condition of wounds. Some of these results are doubtless due to the prolonged dilatation of the arterioles after their primary contraction; others must be explained by the probability that the vitality of the protoplasm is weakened by solutions of suprarenal gland. After hypodermatic injections there is often excitement and tremor, occasionally tachycardia, palpitation and vomiting. Death may occur from cardiac paralysis due to the constricted arteries favoring acute dilatation of the heart or to paralysis of the respiratory center.

Therapeutics of Dried Suprarenals

It may be used as a **local vaso-constrictor** in minor surgery. On account of this property it may be applied to inflamed tissues so that they may be rendered anæsthetic by cocaine. For topical application, a filtered, freshly-made aqueous solution should be employed. It may be sterilized by heat without destroying its active principle. In hay-fever a solution of its active principle is diluted with normal saline solution and used as a spray. It may be used locally to arrest small **hæmorrhages**, and to allay itching. For inter-

nal treatment it is well to commence with a small dose of the dried suprarenal, three times a day, and progressively increase the amount. The pharmacopœial preparation should be given dry on the tongue and swallowed without water. When it is desired to obtain the suprarenal effects by hypodermatic or intravenous injection, solution of the active principle must be employed. This has been isolated and is to be found in various forms in the pharmacies but is not official. It is useful in the treatment of acute and chronic bronchitis, of great value in **spasmodic bronchitis** when given hypodermatically, and in congestion and œdema of the lungs, hæmoptysis, and œdema of the glottis. It may be cautiously used in diseases of the heart, which, as has been stated, it stimulates from direct action on the heart muscle. Dried suprarenals have been used to a considerable extent in the treatment of Addison's disease, but without much benefit. In **shock,** on account of its action as a vaso-constrictor of the blood-vessels in the splanchnic area, it has been proposed to inject a solution of the active principle of the suprarenal gland drop by drop into a vein, timing the rapidity of the injection by the behavior of the pulse. The effect, although theoretically powerful, however, is practically so temporary and the danger from the paralysis of the heart so great that the method is not likely to be often employed. Intra-venous injections generally are dangerous from liability to rupture a cerebral artery in arteriosclerotic patients, to increase a cerebral or pulmonary hæmorrhage or to favor a pulmonary œdema.

DESICCATED HYPOPHYSIS

For the Preparations of Desiccated Hypophysis *see* p. 251.

Action of Desiccated Hypophysis

Circulation.—Locally there is a narrowing of the arteries, intravenously a slowing and strengthening of the heart resulting in a rise of blood-pressure, due to direct action upon the muscle; this action is rapid in attainment and the return to the normal somewhat slower.

Uterus.—Not only is the direct action of the remedy upon the intestinal muscles, causing increased peristalsis, but it also stimulates the uterine muscle, and in large doses may produce violent contractions of the entire organ.

Internal Secretions.—It is believed to lessen the secretion of the thyroid gland when excessive and to diminish the pancreatic secre-

tion. It causes an increased elimination of phosphates, but not of the urates, in the urine.

Therapeutics of Desiccated Hypophysis

Since the pituitary body is thought to be hypersecreting in giantism and to be abnormal in acromegaly, this remedy is contraindicated in the former and of use in the latter only when there is a deficiency of the normal internal secretion. It has sometimes relieved the continuous and severe headaches of acromegaly. It would appear that it might be useful, given intravenously, in shock and possibly hypodermatically in hæmoptysis and in paralysis of the intestinal musculature. It has had, however, an extensive employment in obstetrical practice, notably to relieve **uterine inertia**, for which it is given hypodermatically. The same precautions apply to its use for this purpose as for ergot (*see* p. 797). The remedy has been employed in epilepsy with no beneficial results.

DIVISION XV.—DRUGS ACTING ON METABOLISM

The action on metabolism of many drugs has already been referred to. As our knowledge of the normal metabolism of the body is as yet limited, the statements made concerning drugs now to be considered are chiefly based upon experience. In this place attention should be called to two names in common use, viz.: alterative and tonic.

Alterative.—This is a vague term which cannot be accurately defined. It is often employed to conceal our ignorance of the exact action of a drug, but in general it is applied to agents which appear to modify the nutritive processes and thereby cure or alleviate many diseases of chronic type. They favorably *alter* morbid processes, as in the use of mercury in syphilis, but the *modus operandi*, of which almost nothing is definitely known, probably varies greatly in different drugs.

Tonic.—A tonic has been stated to be a drug which so influences nutrition as to increase the reconstruction or upbuilding of the tissue or tissues concerned. While this definition is not entirely adequate, it is perhaps as satisfactory as any that can be given. Many of the vegetable bitters are also classed as tonics (*see* p. 181).

This division also includes some substances used as foods; for instance cod liver oil.

IODINE AND THE IODIDES

For the Preparations of Iodine and the Iodides *see* p. 36.

Action of Iodine and the Iodides

External.—Iodine is an **irritant, disinfectant,** and **parasiticide.** The first effect of its application to the skin is a yellowish discoloration, which is removable by alkalies or sodium thiosulphate. It acts more slowly than most other irritants, but on account of its volatility and because it precipitates proteids and enters into easily dissociated compounds with them, its action is both penetrating and prolonged. It produces a sensation of heat, accompanied by local hyperæmia and sometimes by more or less œdematous swelling. Some exudation of leucocytes takes place, and the strong absorbent action of iodine has been attributed to this. Unless used in very concentrated solution or in the solid form, which may cause vesication or even corrosion, its irritant action is comparatively mild. By repeated applications, however, it is possible to secure very pronounced counter-irritation without the production of a deep destruction of tissue. The superficial cuticle is usually destroyed, and the skin afterwards exfoliates. As a result of its local application, small quantities are absorbed. The subcutaneous injection of solutions of it causes intense pain and irritation. The inhalation of the vapor of iodine also gives rise to very considerable irritation; exciting sneezing, coughing and some dyspnoea, with smarting, swelling and increased secretion from the nasal mucous membrane, conjunctiva, throat and lower respiratory passages.

The iodides in watery solution are not absorbed from the unbroken skin, but are rapidly absorbed from mucous membranes.

Internal.—Iodine naturally exerts its local irritant action on the gastro-intestinal tract, causing pain and vomiting, and sometimes purging. The drug may be recognized in the vomited matter and in the stools. In very small doses the slight irritation produced on the mucous membrane of the stomach may improve the appetite and digestion, and be followed by a sedative action. In excessive doses it produces marked irritation of the œsophagus and severe **gastro-enteritis,** but death is rarely caused by it. In fatal poisoning the

mucous membrane of the stomach and intestine has been found tumefied and exfoliated. The irritation of the alimentary canal may also prove fatal by inducing collapse and failure of the heart and respiration. In animals, fatty degeneration of the heart, liver and kidneys has been found. Iodine, in the form of iodides and, it may be, in a combination with proteids, is rapidly absorbed by the mucous membranes generally. Its chief effects after absorption may be due to its action on the **thyroid gland.** The symptoms produced by its continued administration, such as acceleration of the pulse and certain nervous phenomena, are much the same as those caused by large amounts of thyroid extract, and are thought to be probably due to the excessive production of the organic compound, iodothyrin, which exists normally in the thyroid gland, and the administration of iodine may lead to an increase in its formation. Iodine is excreted, in the form of iodides, chiefly by the kidneys, but also to some extent in the saliva, perspiration, milk and bronchial secretion.

The effects produced by the iodides appear to vary considerably, not only in different individuals, but also in the same individual at different times, and their mode of action is still a matter of great uncertainty. When administered internally the iodides are absorbed unchanged by the stomach and intestine, and it is found that they make their appearance in the secretions within a very short time, being excreted mainly in the urine, in which they are found as salts; also to some extent in the saliva and in various other secretions, as those of the nasal mucous membrane and sebaceous glands, and in the tears, sweat and milk. By the stomach small amounts are eliminated as hydriodic acid and sometimes as free iodine. No free iodine, however, has been found in the saliva, sweat or nasal secretion. There seems to be no question that some of the iodide undergoes decomposition in the body, because formerly much the same therapeutic effects were produced by the internal administration of iodine which are now obtained with the iodides. On the other hand, the secretion of milk is diminished. Infants have been known to suffer with iodism from being nursed by persons under iodide treatment.

The iodides are supposed to lessen the viscosity of the blood, increase the fluidity of the bronchial mucus, and in pulmonary tuberculosis to interfere with connective-tissue formation.

Iodism.—This is induced by all the iodides, and the basic-ion does not appear to be concerned in the effect. Owing to the fact that

iodine is more readily freed from it, ammonium iodide is said to be more liable than the others to cause iodism. The symptoms may be divided into two groups. (1) **Catarrh of the respiratory passage** is very common and commences in the nasal mucous membrane, exciting a profuse watery discharge, and extends both upward and downward. Accordingly there is conjunctivitis, and severe headache may result from the invasion of the frontal sinuses. At the same time there is much swelling and irritation about the fauces, the tonsils are liable to become inflamed, and laryngitis or bronchitis may result. Œdema of the larynx, which unless promptly relieved may prove fatal, occasionally occurs. The bronchial secretion is increased by massive doses, even pulmonary œdema may supervene. At times there is a febrile reaction, rapid pulse and respiration and great prostration which suggests an acute infectious pneumonia, but a careful examination of sputum and urine and an analysis of pulmonary signs establishes the diagnosis. Usually somewhat later, an eruption may appear upon the skin. This most commonly consists of erythematous patches, but instead there may be papules, which sometimes become pustular and, more rarely, as other forms of cutaneous disease. Œdema of the face is met with in some instances, and very rarely there is albuminuria. Nervous troubles, neuralgia, ringing in the ears, convulsive movements, disturbed cerebration even progressing to delirium, and rarely atrophy of the mammæ and testes may be noticed. (2) **Iodic cachexia,** which is characterized by rapid emaciation, severe cardiac palpitation, and ravenous appetite, occasionally occurs as a late phenomenon. The local manifestations of iodism can sometimes be prevented by the administration of alkalies, and hence it is thought that the variation of their extent in different persons, or in the same person at different times, may perhaps be explained by a different degree of acidity. Children appear to be less subject to iodism than adults. A tolerance may be established, and not infrequently the symptoms disappear while the administration is still being maintained. Although the manifestations may be very severe, a cessation begins soon after the treatment is discontinued, and the chewing of pyrethrum will hasten the elimination of iodine in the chronic forms. However, sometimes the symptoms may not disappear for a considerable time.

Therapeutics of Iodine and the Iodides

External.—Iodine preparations are much relied upon as irritants, **counter-irritants** and **resolvents.** The tincture is one of the most popular of all external applications, while mild in its action, as are also the ointment and compound solution, a sufficient effect may usually be secured by the repetition of its use. The conditions for which these preparations are used are numerous: chronic inflammation of joints, periostitis, lymphadenitis, buboes, abscesses, chilblains, pleurisy, and inflammation or retraction of the gums. The tincture, may be painted over an area of tinea or ringworm, and is usually efficacious in pityriasis versicolor. It is sometimes of service in lupus also, and is curative in lentigo and chloasma. Two preparations of iodine are frequently employed in the treatment of diseases of women, namely: Churchill's tincture: iodine, 5; potassium iodide, 1; water, 8; alcohol, 24; and Battey's fluid; iodine, 2; pure phenol, 1. Fatal systemic poisoning has also been known to result from the injection of large quantities of iodine into cysts. The same objections hold true as regards the parenchymatous injections of the tincture in hypertrophied tonsil, goiter, glandular tumors, etc. In some instances of spina bifida a successful result may be obtained by the injection of Morton's fluid, which consists of iodine, 1; potassium iodide, 3; glycerin, 48.

Internal.—**Goiter** of the colloidal variety may not infrequently be successfully treated by the internal and external use of iodine. For the internal treatment the best mode of administration is to give the tincture in small doses with potassium iodide, freely diluted. Dried thyroids, however, are much more efficient. The compound solution has a good reputation as a remedy in scrofulous affections of the skin and of the lymphatic glands, especially in syphilitic children, and is stated to be useful in some old syphilitic skin diseases attended by thickening and scaling. Judiciously employed, iodine preparations are of some value as inhalations particularly with oil of turpentine, and as adjuvant to other methods of treatment, in laryngeal and pulmonary tuberculosis.

The iodides were largely substituted for iodine in therapeutics for the reason that they are less irritating to the gastro-intestinal tract. Potassium iodide is the one in most general use. The most conspicuous of their applications is in the treatment of **syphilis,** in which their very great value has long been established. It is in the

third stage of the disease that they produce results which cannot be accomplished by any other means; often causing the rapid and definite absorption of nodes, and gummata whether of skin, cellular tissue, coats of arteries, cerebral meninges or periosteum. In order to secure the best effect it is necessary to give large doses in many instances, so that even 16 gm. (4 dr.) may be taken in a day. In syphilis of the nervous system very large doses are especially called for, and daily amounts of 30 gm. (1 oz.) are not infrequently required in these cases. No symptoms of iodism are likely to appear until the disease subsides. What is known as the "mixed treatment" is often resorted to in syphilis, and it is believed by the majority of practitioners to be especially effective in the intermediate period, when the secondary stage is passing into the tertiary. This consists of the combination of potassium iodide with corrosive mercuric chloride; as a result, red mercuric iodide is formed and dissolved in the excess of potassium iodide. It has been suggested that in syphilis the iodides may act as a specific poison (antiseptic) to the cause of the disease, but if this were so it seems reasonable to suppose that they would be much more efficacious in the early stages than is the fact. Their remedial action remains in fact as yet unexplained. In various troubles not directly attributable to syphilis, but occurring in those who have at one time had the disease, iodides are often beneficial.

While these drugs are of little value in acute, they are relied upon to some extent in **chronic rheumatism.** Rheumatoid arthritis would seem to be more amenable to the long-continued use of ferrous iodide than of the potassium salt, which is more commonly employed for its relief. In any affection in which the administration of the iodides must be maintained for a great length of time it will usually be found advantageous to allow occasional intermissions. In so-called gonorrhœal rheumatism the syrup of hydriodic acid is preferable to potassium or other iodide. In subaçute catarrh of the duodenum and of the biliary dusts comparatively small doses of sodium or ammonium iodide may be of service, and the latter, especially when combined with arsenic, is an excellent remedy for the first stage of cirrhosis of the liver. Good results with potassium iodide have been obtained in aneurism, but whether it has any effect, in instances where there is no syphilitic taint, seems doubtful. The iodides are not infrequently useful in promoting the absorption of inflammatory products, as, for instance, in joint disease, pleurisy and catarrhal and fibrinous

pneumonia; and there is much reason to believe that their prolonged use in sufficient dose will be of benefit in **arteriosclerosis**, and amyloid disease of the kidney and other organs. Their use is to be avoided in chronic nephritis and hepatitis of the interstitial variety unless there is high blood-pressure. Simple hypertrophy of the spleen may be cured by the internal use of the iodides and the external application of iodine, and ammonium iodide is often efficacious in removing the enlargements of the spleen and liver caused by malarial disease. Iodides have long been employed in the treatment of goiter, but now seem likely to be supplanted by dried thyroids. Ammonium iodide is highly esteemed in chronic bronchitis and pulmonary emphysema, and potassium iodide is sometimes quite efficacious in relieving the symptom asthma. For the internal treatment of hay asthma it should be given in full doses, and it may be advantageously combined with arsenic. The iodides have been recommended in various cerebral affections, but unless these are of syphilitic origin, not much is probably to be expected from their use. Potassium iodide is occasionally prescribed to diminish the secretion of milk. This salt is commonly given to promote the elimination of lead, mercury and other heavy metals in instances of chronic poisoning from them. The iodide treatment is sometimes of service in non-syphilitic skin diseases. It is regarded as especially useful in actinomycosis and psoriasis. In many of the conditions in which potassium iodide is employed, particularly when the administration is long-continued, it would seem that sodium iodide should be preferred, as it does not occasion so much depression. Strontium iodide is used for the same purposes as the other iodides. It is believed that it is less likely to disturb the stomach, cause acne, and depress the heart than the other iodides. In many instances the syrup of hydriodic acid can be substituted with advantage for the iodides. It is not so likely to produce iodism, nor does it so readily give rise to the "iodide punishment." Its pleasant taste is grateful to most patients, and it should be administered, well diluted, one-half hour before meals, or at least in an empty stomach.

The use of iodine and the iodides should be avoided in patients suffering from pulmonary tuberculosis.

URANIUM NITRATE

For the Preparation of Uranium Nitrate *see* p. 88.

Action of Uranium Nitrate

Uranium nitrate is less radio-active than metallic uranium and some of its salts. It emits both the beta- and gamma-rays but probably their effects are over-shadowed by the other manifestations produced by this substance.

Alimentary Tract.—There is likely to be thirst, nausea and vomiting with constipation and later diarrhœa. It inhibits the production of ptyalin, pepsin and trypsin and its deleterious effects on digestion appear after hypodermatic as well as after oral administration.

Respiration.—This is slowed, while the pulse becomes more rapid and the temperature subnormal.

Nervous System.—The somnolence, weakness of muscles and paralysis are usually not marked until a few days before the death of the animals subjected to experimentation.

Kidneys.—In considerable doses, in some animals, it produces degeneration, necrosis and desquamation of the tubular epithelium with hyaline droplets in the walls of the capillaries of the glomerular tufts. There is, however, no hæmaturia, in spite of the marked congestion. It generally sets up a glycosuria with torpor, somnolence, paralysis, collapse and coma. The urine is usually alkaline and slightly increased in quantity, at least for a short period; then it is diminished and when coma supervenes, anuria is complete. The coma is usually without convulsions unless they are of uræmic origin. The oxaluria present indicates the poisonous effect of uranium and with the emaciation denotes impaired nutrition.

Therapeutics of Uranium Nitrate

It has been used in England as a spray for the throat in 2 per cent. solution, with caution, for various conditions.

Internally it has been employed with good effect in the treatment of **diabetes mellitus** for at least two decades. It will at times markedly diminish the amount of glucose in the urine and this diminution, often to traces, will persist so long as the remedy is continued. In other instances it is entirely without effect. Its use then is purely empirical, without any basis for an opinion whether it will or will not be useful. Indeed while its use is successful in reducing the glucose, lessening thirst, weakness and emaciation, there is no valid explanation of its action. Fortunately in diabetics the urine is

frequently examined so that structural changes in the kidneys are readily and early detected and the treatment at once abandoned. The digestive disturbances also give early and emphatic warning. On the other hand, it has been administered in large doses, and over long periods of time, even years, without any digestive symptoms nor renal signs, and with apparently great benefit to patients suffering from actual diabetes mellitus.

GOLD AND SODIUM CHLORIDE

For the Preparation of Gold and Sodium Chloride *see* p. 82.

Action and Therapeutics of Gold and Sodium Chloride

In small doses gold and sodium chloride is supposed to promote appetite and digestion, to **stimulate the functions of the brain,** and to be an aphrodisiac. Full doses cause nausea and vomiting, and finally impair nutrition. The toxic symptoms resemble those of poisoning by corrosive mercuric chloride.

It is useful in gastro-duodenal catarrh, **hypochondriasis,** and also chronic ovarian irritation and ovaritis, as well as in chronic albuminuria, hepatic sclerosis, and granular kidney, since it prevents hyperplasia of connective tissue. It is a valuable remedy in the tertiary manifestations of **syphilis,** especially of the bones, and presents fewer disadvantages than corrosive mercuric chloride.

GUAIAC

For the Preparations of Guaiac *see* p. 233.

Action and Therapeutics of Guaiac

Guaiac is diaphoretic, expectorant and laxative, and in large doses a gastro-intestinal irritant, producing vomiting and purging. When it fails to act on the skin it is apt to cause free diuresis. In moderate amount it increases the flow of saliva and occasions a feeling of warmth in the epigastrium, and in its local effects in the stomach and by reflex stimulation of the heart it resembles the volatile oils. It is thought to probably have a slight antiseptic action as regards the alimentary canal and the secretions, and when taken in small doses for some time is said to **favorably affect metabolism.** It is also considered to have emmenagogue properties. In some individuals a cutaneous rash is produced by it.

Guaiac is so disagreeable and its therapeutic value rests on such a slender basis that it is not often prescribed. Its effectiveness in many chronic and obscure complaints is due partly to its purgative action. Probably its most useful application is in the treatment of **pharyngitis** and tonsillitis, used as a gargle and also internally, where it often serves to abort the disease, or at all events to reduce the inflammation. In chronic sore throat it is also sometimes of service, and, it is said, more particularly in patients who have had syphilis. The ammoniated tincture, diluted, may be employed as a gargle. On account of its purgative properties, guaiac has been given in habitual constipation. Malt extract is a good vehicle for it, or it may be prescribed in a pill in combination with other remedies. It is thought by some to be of benefit in warding off attacks of **gout**, taken in wafers and followed by lithium citrate, in an effervescent mixture, and the treatment may be maintained indefinitely.

XANTHOXYLUM

For the Preparations of Xanthoxylum *see* p. 234.

Action and Therapeutics of Xanthoxylum

Xanthoxylum has about the same action as guaiac. It produces, when swallowed, a sensation of heat.

It enjoys some reputation as a remedy for chronic rheumatism, and has been used in **chronic hepatic disorders.** For patients suffering from **chronic syphilis** who do not tolerate either mercury or the iodides, McDade's formula may be employed. This is equal parts of the fluidextracts of sarsaparilla, stillingia, lappa, and phytolacca and of tincture of xanthoxylum. The dose is 8 mils (2 fl. dr.), thrice daily. Of the remedies contained in this mixture, lappa and phytolacca are no longer official. The bark, used as a masticatory, is a popular remedy for tooth-ache.

SARSAPARILLA

For the Preparations of Sarsaparilla *see* p. 235.

Action and Therapeutics of Sarsaparilla

Sarsaparilla is not known to have any physiological action.

It is apparently useful only as a vehicle; the compound syrup having an hereditary reputation in the treatment of **syphilis** and

other chronic diseases. On account of its containing an acrid glucoside similar to saponin it should be administered with some care, as intestinal ulceration has been attributed to its prolonged use.

MEZEREUM

For the Preparations of Mezereum *see* p. 236.

Action and Therapeutics of Mezereum

Mezereum has a rubefacient and vesicant action. It is a gastric stimulant, producing in large doses, vomiting and diarrhœa.

In the mouth, it has been successfully employed to relieve toothache, and also as a sialogogue. Internally its use is now practically restricted to its administration, in combination with sarsaparilla, as an alterative in syphilis, chronic rheumatism, and chronic skin diseases, in all of which its value is doubtful.

SASSAFRAS

For the Preparations of Sassafras *see* p. 237.

Action and Therapeutics of Sassafras

Sassafras, of which the official representative is the oil, has the action of the volatile oils in general, with the advantage of an **agreeable odor** and taste. The oil, in small amounts, is frequently added to mixtures to improve their flavor.

STILLINGIA

For the Preparations of Stillingia *see* p. 236.

Action and Therapeutics of Stillingia

Stillingia is in large doses emetic and cathartic, but in smaller ones is employed either alone or generally with other **alteratives.**

It is a valuable remedy in **syphilis** and in those cutaneous and hepatic diseases which are benefited by so-called alterative medicines.

COD LIVER OIL

For the Preparations of Cod Liver Oil *see* p. 249.

Action of Cod Liver Oil

External.—Cod liver oil is emollient to the skin, and, when rubbed in, is absorbed from it.

Internal. *Gastro-intestinal Tract.*—While often well borne by the stomach, it has, especially in large doses, a tendency to cause disagreeable eructations, nausea and sometimes diarrhœa. It is generally believed that it is more **rapidly absorbed** from the intestines than other oils, though the evidence on this point is not altogether conclusive. Some attribute this supposed greater absorbability to the free fatty acids in the oil, the presence of these facilitating saponification and emulsion. While this explanation might hold good as regards the old dark-colored oils, the pale oil now generally in use is found to often contain less acid than ordinary olive oil. In the test-tube, at all events, cod liver oil forms an emulsion more rapidly than other oils.

Tissues.—Cod liver oil is more **readily oxidized** than most oils. As it is a fat which is readily absorbed and readily assimilated, its continued ingestion leads to a marked increase in weight and strength. It is thus a **food** of the highest value, and it is especially esteemed for the reason that many delicate persons who cannot digest ordinary animal fats are able to take this. In addition, there is some ground for supposing that cod liver oil, aside from its admirable qualities as a food, possesses certain peculiar virtues in consequence of special elements, iodine, bromine and phosphorus in its composition. Thus, if it is true, as has been stated, that iodine may occur in the proportion of 1 to 2000 of the oil, the influence of this remedy is not to be ignored. Erythema or acne is sometimes caused by it.

Therapeutics of Cod Liver Oil

External.—The external application of cod liver oil by rubbing it into the skin is undoubtedly of considerable value, although this has been questioned, in instances of defective nutrition or wasting disease, both in adults and children, but the very disagreeable odor of the oil is a serious objection to its use. In infants the common practice has been to apply it simply under the binder. Inunction with cod liver oil has sometimes been practised in adults suffering from squamous skin diseases, and, when other treatment proves inadequate, it may be resorted to in children affected with chronic skin diseases, marasmus, tuberculosis and wasting diseases generally.

Internal.—Cod liver oil is of value in nearly all varieties of **tuberculosis.** The following conditions are regarded as contra-indicating

its use: Diarrhœa, whether due to the disease or caused by the oil, severe hæmoptysis, vomiting, aggravated dyspepsia, and high temperature. When none of these is present, it is indicated in convalescence from acute disease, especially in children, and in all chronic diseases attended with malnutrition and loss of flesh. It is beneficial in strumous synovitis and in caries and necrosis of bone, and both its local and internal use has been commended in rheumatic arthritis with deposits about the joints. In diseases of the skin of **strumous** origin it has been designated as the "sheet-anchor," and there is no question of its utility in tertiary syphilis, chronic bronchitis, emphysema, and various chronic affections of the brain and nervous system. It may be efficient in the treatment of neuralgia, chorea, epilepsy, mercurial tremor, and paralysis agitans, and in atheroma of the arteries it has been found useful in combating degenerative changes and preventing failure in the nutrition of the brain. Here its prolonged administration with the glycerophosphates or hypophosphites is commended. Cod liver oil is invaluable in the treatment of **rickets** and the wasting diseases of children and in these conditions it may often be given with advantage in association with syrup of ferrous iodide. Many infants and young children, take the undisguised oil with avidity. Older persons, however, are apt to object to its unpleasant odor and taste. When such objection is made, the oil may be administered in soft capsules. Some patients are able to take the oil by previously rinsing out the mouth with whiskey or brandy, and others by putting a little salt in the mouth after swallowing it. One part of oil of eucalyptus to 100 parts of the oil is said to entirely do away with the odor and taste. The oil is also sometimes given in ordinary black coffee. The most popular as well as the most effective way of taking it is in the form of the emulsions, or the emulsion with the hypophosphites which is no longer official. A very nutritious combination in which the taste of the oil is quite well disguised is made by rubbing together equal parts of cod liver oil and extract of malt.

DIVISION XVI.—DRUGS WHICH HAVE NO MARKED THERAPEUTIC PROPERTIES

All of the drugs here presented are official and most of them are in daily use in the pharmacies. Their interest to the physician lies in their employment to make prescriptions more palatable or sightly.

VANILLIN

For the Preparation of Vanillin *see* p. 242.

Action and Uses of Vanillin

Vanillin has been asserted to be locally irritant, but is probably inert as regards any action on the human organism. There can be little question that the instances of poisoning which have been reported from the eating of ice-cream and other articles flavored with vanillin were due to ptomaines.

Vanillin has been suggested as a remedy in hysteria, but it is used for the most part simply as a **flavoring agent.**

COCHINEAL

For the Preparation of Cochineal *see* p. 256.

Action and Uses of Cochineal

It has been supposed to possess anodyne properties, but it probably has no such action.

Cochineal is used only as a **coloring agent.** It was formerly employed in the treatment of whooping-cough, in which it had, in former decades, a considerable vogue.

RED SAUNDERS

For the Preparation of Red Saunders *see* p. 242.

Action and Uses of Red Saunders

Red Saunders has no physiological action.

It is used only as a **coloring agent.**

SODIUM INDIGOTINDISULPHONATE

For the Preparation of Sodium Indigotindisulphonate *see* p. 66.

Action and Uses of Sodium Indigotindisulphonate

So far as is known this substance has no physiological action.

It is used as a harmless and distinctive **coloring agent** in the manufacture of the poisonous tablets (toxitabellæ) of corrosive mercuric chloride.

WAX

For the Preparations of Wax *see* p. 257.

Action and Uses of Wax

Wax has no pharmacological action.

Yellow and white wax are used only as **bases for various plasters,** cerates and ointments.

PARAFFIN

For the Preparation of Paraffin *see* p. 49.

Action and Uses of Paraffin

Paraffin has no action owing to its lack of affinity for most solvents.

It makes a good **basis for ointments** used for protecting wounds or sores, but as it is not absorbed, it is not suitable for ointments to be applied in instances in which the introduction of drugs through the skin is desired. In recent years subcutaneous injections of paraffin have been successfully employed for the **correction of deformities,** especially of the nose.

PREPARED SUET

For the Preparation of Prepared Suet *see* p. 256.

Action and Uses of Prepared Suet

Prepared suet has the action of fats in general.

It is used chiefly in the **preparation of cerates** and of similar extemporaneous preparations.

PURIFIED PETROLEUM BENZIN

For the Preparation of Purified Petroleum Benzin *see* p. 49.

Action and Uses of Purified Petroleum Benzin

Large doses give rise to gastro-enteritis, and poisoning may be induced by its inhalation.

Petroleum benzin is used in the manufacture of volatile oils and for depriving powdered drugs of their fixed oil by percolation, and as a substitute for ether in making oleoresins, and for **dissolving fats** resins, rubber and some of the alkaloids. It has occasionally been

employed externally in the treatment of neuralgia, rheumatic pains, scabies and prurigo, and internally as a remedy for tapeworm.

ACETONE

For the Preparation of Acetone *see* p. 100.

Action and Uses of Acetone

Acetone is stated to possess anæsthetic and anthelmintic properties.

It has been given in rheumatism and gout, but its principal use is in pharmacy. It is employed as a **solvent for resins,** fats, camphors, and gun-cotton.

LYCOPODIUM

For the Preparation of Lycopodium *see* p. 244.

Action and Uses of Lycopodium

This was formerly regarded as diuretic but it probably has no physiological action. The powder has the pronounced property of absorbing oils and oleoresins.

It makes an excellent **absorbent** and **protective powder** mixed with an equal quantity of powdered starch, when dusted over an excoriated surface as in the intertrigo of infants. It is also used as a basis for insufflations. As it is powerfully repellent to water, and thus protects hygroscopic substances, it is a good basis for pills, and is extensively employed for facilitating the rolling of the pilular mass and preventing the adhesion of pills to each other.

PURIFIED TALC

For the Preparation of Purified Talc *see* p. 74.

Action and Uses of Purified Talc

Purified talc has no physiological action. It makes an excellent filtering material and it is employed in the manufacture of many pharmaceutical preparations. As a **dusting-powder,** it is useful for erythema, urticaria and other pruritic eruptions.

PURIFIED SILICEOUS EARTH

For the Preparation of Purified Siliceous Earth *see* p. 50.

Action and Uses of Purified Siliceous Earth

This substance possesses marked power of **absorbing liquids** and its only use, which is considerable, is in various pharmaceutical processes.

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